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BOTANICAL OPPORTUNITY.[1]

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IN selecting a subject for the first presidential address before the Botanical Society of America, which you have done me the honor of requiring of me, I have deviated somewhat from the customary lines of such addresses, inasmuch as I have not attempted to present an abstract of recent general progress in botany, nor any results of my own investigation. Such topics, indeed, are more likely than the one I have chosen to interest an assemblage of specialists like this society; but as the society is supposed to have as a principal object the promotion of research, the present has seemed a fitting occasion to address, through the society, the large and growing number of young botanists who may be expected to look to this society for a certain amount of help and inspiration in the upbuilding of their own scientific careers: hence it comes that I have selected as my subject "Opportunity."

Let us for a moment compare the conditions under which scientific work is done today with those prevalent in the past. From a purely utilitarian, and, for a time, perhaps almost instinctive knowledge of plants and their properties, beginning, it may be, before our race can be said to have had a history, through

[1] Address of the retiring president, delivered before the Botanical Society of America, at Buffalo, N. Y., Aug. 21, 1896.

the pedantry of the Middle Ages with their ponderous tomes, botany, almost within our own memory, stands as the scientific diversion or pastime of men whose serious business in life was of a very different nature. Such training as the earlier botanists had was obtained as being primarily useful in other pursuits than pure research, though there is abundant evidence that the master often enjoined upon the pupil the possibilities of botanical study, and no doubt he stretched the limits of botanical instruction deemed necessary, just as is done today in technical schools, in the hope that the surplus might be so used as to increase the general store of knowledge; but, at best, training was limited, and research was recreation and relaxation.

But our predecessors, even the generation immediately before us, lived under conditions which made it possible for a man to hold high place in the business or professional world, to accumulate wealth in commerce, and at the same time to devote much time to the study of nature. Today the man who is not entirely a business man is better out of business, and, with a few exceptions, the man who is not entirely a student is little better than a dilettante in science. Concentration is the order of the day, and specialization is the lot of most men. But specialization, the keynote of progressive evolution, is always intimately associated with a division of labor. Fortunately, the men who enter and win in the great game of commerce and manufacture see in a more or less clear way that nearly every great manufacturing or commercial advance has grown out of a succession of obscure discoveries made by the devotee to pure science, often considered by him, indeed, only as so many more words deciphered in the great and mysterious unread book of nature, but sooner or later adapted and applied for the benefit of all men by the shrewd mind of a master in the art of money-making. To these men, successful in business, we owe it that today not only are some men able to devote their entire time to scientific research and the propagation of knowledge, but that their work is done under favorable conditions, and with a wealth of aids and adjuncts that would hardly have been thought of a generation ago.

Instead of a smattering of systematic botany and organography, given as an adjunct in chemistry, medicine, or engineering, the student who wishes may today equip himself for a life of research in botany, by a considerable amount of preparatory work in the lower schools, beginning, perhaps, even in the kindergarten, and by devoting the larger part of his undergraduate time in college to the elements of the subject in the broadest and, if he wish, technical scope, having the benefit of marvelously detailed appliances and a broad knowledge of general facts. If he can and will work for a higher university degree, thus equipped, he may delve into the depths of the most limited specialty, guided for a time by those who have already broken soil there, and left at last with a rich and unexplored vein for his own elaboration. With this training, if he be fortunate in securing a position offering opportunity for research, or if he enjoy independent means, he may hope for a lifetime of more or less uninterrupted opportunity for unearthing the wealth of discovery that lies just within his reach.

Considering the prevalent conditions, my subject naturally divides itself into two quite distinct parts: the opportunity of institutions and of individuals. We stand today, apparently, at a transition point. Most of the active workers of the present time are college professors who have done the research work that has made their names known, during the leisure that could be found in the year's routine of instruction or during their long vacations, and with facilities nominally secured for class use, or, in many instances, like those of a generation ago, the private property of the investigator. Even when appreciated at something like its true value, their original work, for the most part, has been closely watched to prevent it from encroaching upon the first duty, class work; and in most cases the facilities that they have been able to bring together are in direct proportion to the number of students attracted to their departments, and therefore in inverse ratio to their own leisure for research. But, as I have already stated, the feeling is growing among men able to foster such enterprises, that research is a thing worthy of being

promoted, and we have before our eyes the spectacle of a gradually unfolding class of institutions in which investigation is not only tolerated but expected, either as an adjunct to instruction, as in the greater number of colleges, as a concomitant of educational displays, as in botanical museums and gardens, or, at least nominally, as a basis for technical or economic research, as in several of the larger drug houses, and, notably, in various agricultural experiment stations and the national Department of Agriculture. Perhaps the time has not yet come when laboratories of botanical research can stand out quite alone and justify their existence without reference to other ends, the utility of which is more generally understood and conceded, but it seems safe to predict that the next decade will see their complete evolution.

Opportunity for institutions lies primarily in equipment, and secondarily in its use. The problem of equipment for research is a complicated and difficult one. So long as there were no laboratories especially designed for this purpose, it was natural that the instructional laboratory should be furnished with appliances for demonstration, and that these should be amplified as far as possible, for the repetition of experiments, in the first place, and afterwards for their extension ; and it is no doubt true that a number of the smaller educational laboratories are today over-equipped when account is taken of the possible use to which they can be put. With a specialization such as we now see in progress, it may be questioned whether the ordinary collegiate equipment cannot be reduced in scope in many instances, with benefit to the institution, by releasing money often badly needed in other directions, either in the same or different departments. On the other hand, it is certain that the equipment of the broader research laboratories, whether connected with universities or independent, must be made much more comprehensive than any which today exists in this country.

Under the stimulus of the last two decades, botany has come to the front in most colleges as a study well calculated to develop the powers of observation and the reasoning faculties. Where

it still occupies the place of a fixed study of a few terms' duration in a prescribed undergraduate course, it is evident that the necessary equipment of a department is expressible in the simplest terms: for each course, that which is needed to exemplify by the most direct object lessons the subject selected, and enough general and collateral material and literature to complement the work. But the case is somewhat different when, as is now frequent, a considerable option is allowed the student in the courses taken for the baccalaureate degree. Here the temptation exists to secure equipment for the broadest possible series of electives, and it is too often yielded to for the best interests of the institution. However liberal one may be in the matter of electives, it is evident, in most instances, that the student cannot afford to devote more than about one-half of his undergraduate time to a single study like botany, and in this time he can cover only a definite amount of ground. While there is a certain seductiveness in the perusal of long lists of electives in a college catalogue, the serious contemplation of them shows that few, if any, students can hope to take all of the courses of such a list, and as, for the most part, they are garnished out in an attractive form, there is likely to be embarrassment in the wealth of subjects, so that, if left to himself, the student is very likely to select a series of disconnected but pleasing fragments, rather than the proper links in an educational chain. Experience shows the wisdom of limiting the list of electives to those that there is reasonable probability that the student can take, and of making the list a consistent whole, fairly opening up the entire field of botany in such manner as to pave the way for a piece of advanced thesis work at the end, and for specialization after graduation. So far as undergraduate instruction is concerned, where, as is usually the case, funds are limited, it is here desirable, as in the other instance, to limit the scope of the departmental equipment quite closely to the requirements of the courses offered. As the senior thesis work is almost certain to be a further study of some one of the subjects already elected, the provision for it, in nearly every instance, is easily and quickly

effected by a comparatively inexpensive addition, in each case, to the standard library and laboratory equipment. Such research work as the head of the department and his assistants find time for, as well as such post-graduate work as may be undertaken, can then be provided for in the same manner, piece by piece, with the exception of the final touches, demanding the use of the largest reference libraries or collections, the provision for which is not likely to be far to seek in the stronger research centers within a very few years.

Great herbaria, broad reference libraries, and large stores of apparatus and living or preserved material are possible only to few universities and to the still fewer institutions specially endowed for research, to which alone, indeed, they seem strictly appropriate. For the latter every shade of breadth of foundation is possible, from the laboratory and library limited to the narrowest specialty, to the institution founded and equipped for research in any branch of pure or applied botany. Fairly perfect equipment of the former class it is possible to find here and there, today, but though the seed is sown in several places, the broadest institutions, in their entirety, are still to be developed.

No doubt the first requisite in any such institution is a library of scope comparable with its own. Whatever may be said against the prevalent nomenclature discussions, it must be admitted that they are having the effect of bringing to the front the half-forgotten work of many of our predecessors, some of which, at least, is well worthy of resurrection, and incidentally this is stocking our larger libraries with a class of books which have confessedly been too much neglected of late. Without for a moment losing sight of the fact that botany is a study of one branch of nature, an object-study, we must recognize that its prosecution beyond the merest elements is not only greatly promoted by but almost dependent upon a knowledge of what has already been done.

Where an institution is located in a literary or scientific center, closely associated with large general libraries, learned

bodies, and the like, it is usually relieved of the necessity for purchasing and keeping up the long files of such serial publications as the journals, proceedings of societies, etc., of mixed contents, which prove expensive alike in cost, binding, and space, which for a given subject are used but seldom, and which, nevertheless, are the most valuable part of a large reference library, since they are the hardest to duplicate. But where a botanical institution stands in absolute or comparative isolation, it must carry this burden in addition to that of maintaining a library of treatises on botany alone. And, moreover, no sooner is research begun in any direction, than the necessity of following up divergent threads running in many directions becomes evident; for so close and complex are the interrelations between things in organic nature, that no single subject can be pursued far without drawing in others at first sight having no possible bearing on it. After the serials, which from their expensiveness can be possessed by only the larger libraries, stand undoubtedly the general classics in the several subdivisions of botany, followed by the more restricted memoirs, and among these, for convenience of use, should be found, whenever possible, separates and reprints from the journals and series of proceedings, even when the latter are complete on the shelves.

Next to books, material preserving records, or available for study, forms the great foundation in any research institution. A generation ago, or even less, this expression would have been taken as synonymous with an herbarium, perhaps associated with a garden of greater or less extent; but today the most comprehensive of museum possibilities must be added, so greatly has the subject broadened and increased the needs. For a broadly planned institution, with ample means, no doubt the scope of the herbarium should be as great as that of the library, comprising every group of plants, representing a wide range of geographical distribution, the effects of cultivation, etc., and, however limited they may be at first, such museum accessories as alcoholic material, large wood and fruit specimens, and sections for microscopic study are sure to accumulate quite as rapidly as

they can be cared for suitably, and to prove in time a very important part of the equipment. Though some of the best botanical work has been performed entirely in the herbarium, there has long been a growing conviction that for certain groups of plants, even for purposes of description and classification, field observation is absolutely necessary, while it is self-evident that for all studies of biology living material is essential. Side by side with the herbarium, then, and virtually as a part of the same general collection, stands the experimental garden, with the greenhouses and other appliances.

While many of the most useful studies are made with but few aids beyond the library and collections referred to, there is a large class of subjects now being closely followed by some of the keenest investigators which demand a special instrumental equipment. However it may be with library and collections, there seems little doubt that as a rule apparatus should be obtained only as it is needed for direct use. Except for the rotting of the bindings observed in the libraries of manufacturing cities, and where illuminating gas is used, books, when once classified and indexed, are easily and cheaply kept in a usable condition. If a few simple rules are followed, herbarium material is also preserved safely for generations at a very small cost; and even sections and specimens in fluid, if properly preserved in the first place, may be kept for many years without great deterioration. Instruments designed for research, as a general thing, represent a considerable sum of money, since, excepting microscopes, microtomes, and balances, they are rarely made in numbers allowing a great economy in the labor of manufacture. Each of them is also, unfortunately, with few exceptions, calculated for a restricted class of experiments and likely soon to be greatly modified. Apparatus, moreover, is usually of a delicacy of adjustment calling for the greatest care in handling it and the most perfect protection possible against rusting, etc., so that as a general thing a case of instruments ten years old is merely a historical curiosity, in part entirely out of date and for the rest so badly out of order as to be nearly or quite useless.

Except for a few standard instruments, I think it is not generally recognized that this part of the facilities, however costly it may be, should be regarded as transient, perishable material, rather than a permanent equipment. The history of the most successful physiological laboratories in which delicate apparatus is chiefly used furthermore shows that the most important results, as a rule, are not obtained by the use of commercial instruments, but by simple apparatus designed by the investigator to meet the precise needs of the problem with which he is busied, and usually constructed by him or his laboratory mechanic at very little cost.

Although it seems comparatively easy to decide on the proper limits of library, herbarium, and instrumental equipment for a given institution, knowing its scope, situation, and resources, it is very difficult to arrive at as satisfactory a conclusion concerning the extent of the research garden. As a general thing such gardens are also intended to be useful in college work, or to afford pleasure and instruction to the public, so that they are likely to be heterogeneous almost of necessity, and usually they are made far too comprehensive. More than any other class of facilities, garden plants require constant and expensive attention if they are to be kept in useful condition; and with all of the care that can be given them they are forever performing the most inexplicable and unexpected gyrations with their labels, so that the collections grown in botanical gardens (because of their variety) are notoriously ill-named, though it would naturally be supposed that they, of all collections, would be above suspicion in that respect.

My object being to speak of facilities for research rather than education or entertainment, I ought to pass by this part of the subject with a mere mention, but I can hardly dismiss it without comment. Where the only object is to supplement the facilities for undergraduate work, the scope of a garden can be very small or moderately large, according to the courses it is to help elucidate. It may be confined to what may be called a propagating bed for plants needed in quantity, either in season

or out of season, for class use, to an exemplification of the natural affinities of plants, or to various other instructive synopses representing medicinal plants, fiber plants, forage plants, fruits, vegetables, timber trees, nut trees, shade trees, carnivorous plants, climbing plants, the sleep of plants, pollination, dissemination, etc., or it may be devoted to several of these combined. If it is to be a pleasure-ground as well, not only should the art of the landscape architect be invoked in the arrangement of the plants, but it is necessary to add collections of decorative shrubbery and a large variety of purely ornamental florists' forms of herbaceous plants. If research is added to its aims the collection must be further augmented by specially selected groups cultivated from time to time as needed for study.

Unfortunately, few if any gardens are so richly endowed that they can cover, in a satisfactory manner, the entire field indicated, or even any large part of it. From what has been said of the peculiar difficulties pertaining to the maintenance of botanical gardens, it is evident that in no other line of facilities, whether for pure research or not, is a wise restriction so necessary as here. Once properly prepared, a species is represented in the herbarium on one or more sheets of paper safely and economically stowed away in a pigeon-hole; but in the garden it is a constant source of care and expense as long as it lasts. Hence it is possible for one of the larger herbaria to contain representatives of more than half of the 200,000 species, more or less, of phanerogams, and a considerable, if smaller, proportion of cryptogams, while it is absolutely impossible for anything like this number to be represented in a living state in the best garden. No doubt the local requirements of every institution will do more to influence the exact scope of its living collections than any theoretical considerations, but it is certain that in most cases the greatest usefulness combined with the minimum expenditure will be reached by adapting the synopses chosen to the chief aims of the institution, as closely as possible, and very rigidly

restricting the species cultivated to the smallest number capable of adequately expressing the facts to be shown. Perhaps it is safe to say that an institution able to maintain an herbarium of half a million specimens, representing one-fifth as many species, is doing exceedingly well if it has in cultivation at any one time 10,000 species of the higher plants, and there are very few gardens which actually grow half of this number, while no inconsiderable percentage of the plants cultivated are so deformed, distorted, dwarfed, and imperfect, as a general thing, that they can scarcely be said to represent the species whose name they bear, either in appearance or technical characters.

This leads to the conclusion that not only class gardens but research gardens should be kept within reasonably narrow bounds, so far as permanent planting is concerned, while allowing sufficient elasticity for rapid and ample temporary expansion in certain directions along which work is planned. This does not necessarily mean that any considerable amount of land not used in the permanent plantation need be reserved for special expansion. As a rule the more important gardens are situated in or near large cities, and the high price of land alone would prevent such reservation in most instances; but the impure atmosphere of many of the larger cities is a further and even stronger reason for selecting for any large experimental undertakings a suitably located and oriented tract of farming land easily rented for one or several years at a relatively low figure.

Granting the wisdom of such temporary adjuncts to a research garden, a step further leads to a recognition of the possibility of securing the most varied climatic conditions by establishing branch gardens located where particular kinds of study can best be carried on. In no other way can gardens be made to contribute to the fullest extent to the study of marine or seaside plants, alpines, or the great class of succulents, etc., characteristic of the arid regions of our southwestern states and territories, and in no other way, except in the field, can these

groups be studied satisfactorily, even from the standpoint of the classificatory botanist.

Undoubtedly, too, the research institution of the future will count as a part of its legitimate equipment the provision, as needed, of very liberal opportunities for the staff to visit even distant regions for the study in their native homes of plants which cannot be cultivated even in special gardens in such a manner as to be fully representative.

If the entire equipment here sketched in outline is not only appropriate, but essential, to the great centers of botanical investigation that are making their appearance as results of the specialization and division of labor that are now manifesting themselves in the endowment of research, it by no means follows that every institution, even of this class, should try to develop from the start on all of the lines which, intertwined, compose the complex tissue of botany. With ample means, the ideal development is that which, from the beginning, recognizes all branches as of value, and classifies and develops them alike in proportion to their relative importance. But to secure the greatest return for the money expended, it is desirable to equip fairly well before increasing the force of salaried men much beyond what is needed for the care and arrangement of the material accumulating. This principle, if followed out, almost forces an over-development in the branches of special interest to the earlier employés—a departure from the ideal symmetry, which is sure to be justified by the performance of more work in these hypertrophied specialties, with reference to the sum invested, than in other directions. From this may also be drawn the seemingly just inference that where the means are limited, it is far better to concentrate the entire equipment on the specialties of the persons who can use it, than to allow them to work at a disadvantage through an effort, however commendable it may at first appear, to secure a symmetrical equipment.

With the evolution of centers of pure research will appear new problems. Just as the attendance of a large number of students in the botanical department of a college has heretofore

been found to justify the acquisition of facilities beyond the power of their immediate use, it will be found that where research institutions exist in close connection with a university of recognized standing, their equipment will be utilized more or less fully in postgraduate work done toward the acquisition of the doctor's degree, so that, like the undergraduate equipment, it will be more or less satisfactorily accounted for by the number of candidates for such degree; but with broadly grounded and well endowed research institutions not so situated, it is inevitable that as they take permanent form on the lines caculated to make them available for advanced research in any line of botany, they will sooner or later come to represent a very large sum of invested money, of which only a part is usefully employed at any given time, the remainder being held as a necessary but temporarily unproductive reserve. The same thing is seen, to a certain extent, in all large libraries and museums; but, unlike the general library, of interest to the entire reading public, or the collection of historical or political works, referred to by many people of ordinary intellectual attainments, the advanced equipment in botany, for the most part, is useful and interesting only to botanists, so that, while it may possess a passing interest for the general student, its serious use is limited to a very restricted class. How to increase this use to the maximum may well demand our best thought.

No doubt, just as many colleges now offer scholarships, making their advantages available to men who otherwise could not enjoy them, and some of our universities offer fellowships, opening their own postgraduate courses or those of foreign universities to deserving students, the evolution of research institutions will witness some such provision for enabling students who have partially completed pieces of research work to visit and utilize these centers without encroaching too far on the limited savings from the small salaries which, as a rule, are drawn by the botanists of the country. After all, however, the great opportunity of attainment, for such institutions, whether or not connected with colleges or universities, lies in the performance of research work by their own employés; and while, except in

the few instances already referred to, and notably in the national Department of Agriculture, today there is some hesitancy in recognizing the employment of a staff of investigators as a legitimate part of the maintenance expense of an establishment which does not use a large part of their time in instruction or necessary curator's routine, it is quite certain that within a very few years opinion will have so changed that a considerable number of salaried positions for research work or applied botany will exist; and as these positions will compete with the professorships in the best universities, it seems probable that the salaries pertaining to them will be approximately those paid at the larger colleges.

In addition to bringing together facilities for research and rendering them easily accessible to competent investigators, and maintaining their own corps of workers, engaged in such studies, institutions of research have no small field of usefulness opened up as publishers of the results of the work they have promoted. I shall have occasion later to speak of the means of publication from the standpoint of the student who is seeking to bring out his work in the best form; but it also demands consideration from the point of view of the institution. Much difficulty is experienced in looking up the literature of a subject because of the large number of journals, etc., in which references must be sought, and it is probable that at some time or other most workers have impatiently wished that publication could be confined to one or a few channels. Simple as this would render the bibliography of botany, it is obviously impossible; and the amount of work deserving or demanding publication is so great, and so rapidly increasing, as to leave no doubt that means of effecting the latter must be considerably augmented. To publish the results of good work well is no less commendable or helpful than to facilitate or perform such work. Nor is it less appropriate to an institution such as I have in mind. The object of publication being the adequate preservation and diffusion of a record of the results of research, however, it is easily seen that harm may be done by injudicious or ill-considered publication. While a volume of homogeneous contents may be so published

almost anywhere as to accomplish its purpose, a serial publication ought to be started only when there is reasonable probability that it will persist for a considerable length of time. Granting this probability, a research institution with adequate funds forms one of the most satisfactory and effective agencies of publication, since it can place its proceedings or reports in all of the principal libraries of the world, a thing which the journals do not always accomplish; and not only can it thus amplify its field legitimately, but almost of necessity it must assume the duty of publication if it is to accomplish the greatest results possible from its direct investigation.

One has only to pass a short time in the library of one of the larger scientific institutions to be convinced that a great deal of activity is manifested in the botanical world. Each month and each week bring many additions to the literature of the science, and so numerous, varied, and widely scattered are these contributions, that one feels the greatest hesitancy in publishing on even the most restricted subject, lest others should have antedated his discoveries. Yet notwithstanding the variety and number of botanical publications, and the great progress which is undeniably made every year, it is a matter of frequent comment that the progress made is by no means so much greater than that of our predecessors as might be expected, considering the greater advantages under which work is prosecuted today. While it must be borne in mind that the seizing of the general features of a landscape is far easier than the working out of its detailed topography, that the outlining of the field of botany or of its principal divisions could not fail to proceed more rapidly, even under unfavorable conditions, than the elaboration of the details of the many specialties into which it is now broken up, so that less prompt and voluminous results are naturally to be expected now than a generation ago, there is reason to question whether the present returns cannot be increased. How to secure the greatest possible results from the large number of trained men holding or soon to hold salaried positions, and from the large equipment in laboratories, libra-

ries, herbaria and gardens, is a subject deserving of the most careful study, whether viewed from the standpoint of the endower or administrator of an institution of education or research, or from that of the botanist whose reputation is built up in the performance of the duties assigned to him in such an institution.

While there is every reason to expect large returns from the endowment of such independent departments of research, freedom from the duties of the class room, while leaving more time available for investigation, will not prove an unmixed blessing. I believe it to be the experience of the best investigators in this country that research is promoted by the necessity of imparting some or all of its results in the class room. In no other way, after specializing in the small field to which it seems necessary for most of us to confine ourselves, can one make sure of preserving the breadth of view needed for the investigation of even a limited specialty in the most successful manner. It must be admitted further that the power of application and concentration varies with different men, so that up to a certain point the interruptions introduced by limited teaching or looking after collections in many cases may give fresh zest to the pursuit of knowledge in the time remaining for research. And it may be that at this very point lies the greatest difficulty to be met and surmounted in the development and management of research institutions.

While there is no doubt that some supervision and pressure are conducive to the performance of the greatest possible amount of investigation, as of other work, since they insure consistent planning and close application, it cannot be overlooked that this is the extent to which scientific work can profitably be crowded. To require more of an investigator than that he shall be reasonably busy with thoughtfully planned study is and has always been antagonistic to the performance of his best work; and the requirement of some institutions that a bulletin shall emanate from each department at stated intervals, while it insures quantity in publication, generally does so at the expense

of quality of attainment. As a rule, genius, which, left to itself, now and then leaps to the most unexpected accomplishments, is most effectively repressed by close supervision. It is tolerant of guidance but not of the goad; and yet, on the whole, perhaps, both guided and driven, if this is done wisely, it accomplishes most, for in harness it becomes plodding research, which is dull, to be sure, but, if persevering, productive of cumulative results which become of incalculable importance. In fact, whether fortunately or unfortunately I shall not attempt to say, the world has come to recognize the slow but sure progress of research as in the main more desirable than the irregular and intermittent leaps of genius, though the two are closely akin, patient labor over endless facts, on the one hand, and broad observation and untrammeled thought, on the other.

If, everything considered, it is slow and persistent investigation, rather than sudden inspiration, to which we must look for the accomplishment of the greatest collective results in botany, it is equally true that the individual student is more likely to build his reputation on the summation of the small accomplishments of many days of close application than to arrive at some great discovery by a leap; and this quite aside from the fact that the latter result is entirely impossible to many a man who in the other way may still hope to be of great usefulness. It has been said that there is a tide in the affairs of men, which, taken at the flood, leads on to fortune, and no doubt what is true in the military, literary, and commercial world is equally true in the smaller realm of science. In fact, I fancy that each member of my audience has in mind some one preeminent occasion which may have looked small or large at the moment, but the seizing or neglect of which he now sees marked a turning in his scientific career. But, it will be seen, it is not of the one great opportunity that I would now speak. Improving it always has marked and always will mark the turning point of life, but unfortunately the bridge cannot be crossed before it is reached, and great as the value of a true and wise friend's counsel then is, it cannot be replaced by any generalities in advance; there-

fore it is to the countless lesser opportunities, repeated with almost every day that dawns for us, that I turn, in the hope that something helpful may be said of them, and in the firm belief that in them lies the making of any intelligent and indefatigable young man.

To the investigator breadth of foundation is even more necessary than to the institution founded for his use, for while the latter should endure for centuries, and may be remodeled and improved at any time, he is limited to a single lifetime and can rarely in mid life or later repair the deficiencies of ill advised or defective training. Not only should his powers of observation be well developed, but he should be given more discipline in reasoning than is now customary, though the botanists of a generation ago counted among their number several men who are even more widely known as philosophers.

Equipped for the work, and enabled to use the material facilities that have been brought together against the day of his need, much depends on the early and wise formulation of the investigator's plans. Except for the tasks set by a teacher and really long contemplated by him and carried out by his intelligence if through the eyes and hands of pupils, few pieces of valuable research are taken up on the spur of the moment, without previous thought on the part of the investigator. They are usually the outgrowth of another, and turning and returning until it ultimately shapes into a definite plan. Simple as it may be in theory, few things are more difficult in practice than the formation and inception in early life, inexperienced, and often without certainty of the power of continuance for any great length of time, of a plan for a single piece of research work worthy of the devotion of a lifetime; and few and fortunate are the men, even among those who have outlined and entered upon such a task, who are not forced from the path by side issues, or whose lives are not unduly short. More commonly one must be content to choose several smaller subjects, for their own sakes somewhat closely related to one another, if possible, and to follow these up in succession. It is surprising how blind even the sharpest eyed

among us are to all that does not directly interest us, and it is an equal surprise to see how quickly one's eyes open to things which he has once begun to think of and look for. If for no other reason than this, I would again urge breadth of early training, as giving the first impulse to many a series of special observations to be followed up in later life.

Once a subject is chosen, observations accumulate with surprising rapidity, and next to the selection of a subject nothing is so important as system in pursuing it. If we do not see it in ourselves, each one of us can see in others, a great waste of energy, resulting from shiftless and ill-considered methods of procedure, by which the mind is so distracted and the memory so overloaded with unessentials and dissociated fragments that those which belong together are not matched, nor the missing bits, in plain view, gathered. How often do we have to return time after time and review partial work that we have had to dismiss temporarily from the mind, in which, meantime, has been lost the connection between the completed portion and the continuation awaiting our leisure. A phenomenal memory may enable one to work in this disjointed fashion without the production of scrappy results or the review of all that has been done each time that the task is resumed; but for those not so gifted, order and method are absolutely necessary, and next to the clear idea of the end aimed at I should place the immediate making of full and exact notes as their most essential part. Some years since I was privileged to assist Dr. Gray in collecting and republishing the botanical writings of Dr. Engelmann, and it was a matter of surprise to us both, as it has been to others, to see how voluminous these were. Had Dr. Engelmann devoted his entire life to botany they would have been as creditable in quantity as in quality, but for the leisure hour productions of a busy professional man they were truly marvelous. Some years later, when, his herbarium and library having found a resting-place at the botanical garden in the development of which he had felt an interest for many years, it fell to my lot to arrange in form for permanent preservation Dr. Engelmann's manuscript notes,

sketches, etc., I was far more surprised at the extent of these than I had been on collecting his printed works, for when mounted and bound they form sixty large volumes. In addition to their intrinsic value, these are of more than usual interest as showing the methodical manner in which Dr. Engelmann worked. On his table seems to have been always a bundle of plants awaiting study. As each specimen was examined its salient features were noted and sketched on the back of the ever ready prescription blank. When interrupted, he laid his unfinished sketch away with the specimen, to resume his observation and complete his study at the first opportunity, without any doubt as to what had been seen in the first instance. And so from individual to variety, from variety to species, from species to genus, and from genus to family, his observations were preserved in memoranda that facilitated the resumption of interrupted work at any time and after any lapse of time. In no other way could the odd moments between the daily calls and occupations of a busy physician have contributed so much to botanical knowledge; in no other way could his seemingly small opportunity for investigation have been converted into a great one.

Almost as important as the early selection of a worthy subject for study and the adoption of a method insuring the preservation and use of even the most trivial information bearing on it is the adoption of suitable library methods. The student whose specialty is small and little explored has mainly the task of observing and reasoning from the facts before him; but in the departments that have long been the subject of study, while a part of the work is already done to his hand, and the prospect is that he can go much further than on entirely new ground, the task of ascertaining and profiting by what his predecessors have done is often a difficult one. Not infrequently the literature of a subject is so scattered as to make it next to impossible to pass it all in review, and at best the task of finding the fragments is one calling for a special faculty. One or more attempts have been made to form general bureaus of scientific information to which one need only turn if he would be possessed of references

to the principal literature of any subject in which he chanced to be interested. Perhaps as library facilities accumulate at the great centers of research, some method may be found of supplementing them with the skill of expert librarians who shall be able and willing to carry the contents of the library, at least in skeleton form, to those who cannot come to it; but the time has hardly yet come when any American library is complete enough in all branches to offer this aid with a reasonable chance of doing what it promises, or so manned as to make such assistance possible except at the sacrifice of more valuable direct research.

For the present, then, the investigator must be content to do his own delving into the literature of his predecessors. Fortunately, much of the earlier literature has been sought out by some of the writers on any branch that has been the subject of earlier study, so that, starting with a memoir of recent date, one is guided to others, each of which may bring further references, until, if he have access to the works, almost the entire earlier literature is unearthed. On the other hand, the most recent literature of a subject is always the most difficult to find and use. After a study has been gotten well under way, so that the student is keenly alert to every observation or published item in any way bearing on it, if he have access to a library receiving the principal current journals he is not likely to overlook any important publication on his specialty which then appears. As a rule, all of the larger papers, at least, are noticed in Just's *Jahresbericht*, generally not more than a year later than that for which the volume purports to be compiled; but as the *Jahresbericht* is always some three years in arrears it is difficult to prevent notes extending over a period of this duration from being defective, at least for the earlier part of the time, and there is at present no means of removing this difficulty, though the plan proposed to zoologists a year ago, and, I suppose, tested during the present season, if successful would be equally applicable to botany.

So far as the final result is concerned, perhaps the manner in

which one's work is published is almost as important as the subject selected or the method adopted for its investigation. Alphonse de Candolle, in one of the most helpful treatises ever published in the hope of rendering botanical work methodical and productive,[2] lays a great deal of stress on the early selection of a form of publication for the results of each important study. This done, the work continually shapes itself to this end. Frequently there is much difficulty in securing the publication of a monograph or memoir in precisely the form and place desired by the author, but there is seldom an insuperable obstacle in the way of publishing any really meritorious work in about the manner wished, provided it is suitably prepared.

In general, it is desirable that works of a given class should be so published that in seeking one a reader is likely to learn of another. This appears less important for books than for shorter papers, since the arrangement of independently issued volumes in a library, and the fact that they are catalogued by authors, render it relatively easy to learn of and have access to them; but even here one finds no little convenience in the recognition that a book by a given author on a given subject is quite likely to be listed in the catalogue of a certain publishing house. Smaller papers, which are usually published in the proceedings of some society, or in a scientific journal, may almost be said to be made or ruined by the place selected for their publication. Probably as library facilities increase and are more thoroughly classified and subject-indexed, this will become less true than it now is, though the underlying reason for it will remain. Usually a reader turns to the popular journals only when looking for popularized science, and is not likely to seek the original results of research there, so that such papers are nearly or quite lost for a long time if published in these journals. Except where they are chiefly devoted to digests and abstracts, few nominally general journals now exist which do not lean so strongly toward a specialty that one unconsciously classes them with it, notwith-

[2] La Phytographie, ou l'art décrire les végétaux considérés sous différents points de vue. Paris, 1880.

standing the extraneous matter that they contain. While nothing once published is ever absolutely lost, all of this extraneous matter is likely to be overlooked by the persons most interested in the subjects considered. No small part of the present confusion and strife in botanical nomenclature arises from the comparatively recent unearthing of descriptions and names of plants published in such improbable or inaccessible places as to have escaped the attention of those whom they might have helped most, to be brought to light at a later date as great mischief makers. From now on, then, it may be concluded that a decreasing number of special papers are likely to be published in general journals, which will become more and more popular or bibliographic in their nature, with the exception that the necessarily slow differentiation of learned societies into special sections will for a long time cause the proceedings of many of the older to continue of the most miscellaneous character. Where papers are lengthy, though not adapted to publication in book form, such proceedings virtually offer the only means of printing them, and, except by the comparatively few botanists who enjoy the privilege of membership in purely botanical societies with publishing facilities, they must be accepted for the present, notwithstanding the attendant disadvantages. Shorter papers, however, can usually find room in the journals, and except in cases where they possess a temporary and exceptional value for the columns of a popular or general journal, or one devoted to another subject to which in some manner they are relevant, they are best published in a periodical exclusively devoted to botany, and, in most cases, in one devoted as closely as may be to their particular branch of botany, provided it have a fair general circulation and, especially, provided it reach the principal botanical libraries.

Especially in the earlier years of their work, writers are sometimes given to distributing their papers among a number of journals. Except for the purpose of specialization just referred to, this is usually a mistake. Knowledge that a certain student has published on a given subject is often first obtained through

incidental reference, lacking every element of precision. The probability that all of his writings are to be found in one or a few journals, or series of proceedings, greatly simplifies the completion and use of such references, since the Royal Society's Catalogue, though perhaps more complete as to titles, is necessarily even farther behind than the *Jahresbericht*. Where the subject of an earlier paper is again passed in review by the author, only the gravest necessity should lead to the selection of a new medium for the publication of the later paper.

Whether the medium of publication selected or accepted be a journal or the proceedings of a society, the possibility of having separates struck off for the mere cost of press work, paper, and stitching, makes it possible for almost any paper to appear as an independent pamphlet, accredited, to be sure, to the journal from which it is an excerpt, but a book, necessitating author's citation in catalogues, and admitting of more ready arrangement in its proper place where the works of a library are disposed on the shelves according to subject. The time was when a pamphlet was considered of little value and quite certain not to be preserved, but one of the characteristics of the modern librarian is a great and growing appreciation of the value of this class of works, leading to their careful preservation.

No small part of the volume of M. de Candolle, already referred to, is devoted to very explicit and well considered directions for preparing the record of one's observations for the press; and the general conclusion is reached, after a careful analysis of the subject, that the maximum value of any manuscript exists at the exact moment of its completion, indicating this as the most suitable time for its publication. Though it is probable that the publishing of any important work should not be unnecessarily delayed after it has been pushed to what the author considers completion, at least so far as he can carry it, there may be reasons in some cases for publishing a preliminary statement considerably in advance of the completion of the work. Neglecting the publication of an early abstract of unfinished work as a means of securing priority, too often a

purely personal matter, I may say that such abstracts, coupled with a request for material or data, not infrequently bring to the advanced student the means of greatly increasing the completeness and value of his work.

Time does not permit me to go into a detailed analysis of the many ways in which an investigator may use his time so as to make it productive of important results for himself and others. Having passed in somewhat comprehensive though hasty review the main factors in the question, I desire in closing to repeat that for most of us opportunity of life does not lie in a great and abrupt change of condition, but that it is composed of countless minor chances which are great only when viewed collectively. To see and use them calls for alert senses, a knowledge and use of the means of ascertaining what has already been done, and, by exclusion, something of what remains to be done, facilities adequate to the task in each case, and indomitable perseverance and ceaseless activity. Great as the value of facilities is, they are merely means to an end. They accomplish nothing themselves. Hence though it is certain that the most voluminous and, perhaps, the most comprehensive results, and those resulting from the performance of coherent experiments extending through a long series of years, will come from the great centers of research, there is no reason why qualitative results equal to the best may not continue to come, as they have in the past, from isolated workers, to the rounding out and completion of whose studies the facilities of the larger institutions will be more and more applicable as the problems of equipment are worked out.

MISSOURI BOTANICAL GARDEN.

BOTANICAL PAPERS AT BUFFALO.[1]

BOTANICAL SOCIETY OF AMERICA.

CONWAY MACMILLAN: *On the distribution of plants in a fresh-water insular region.*— The locality studied was Lake of the Woods, with its thousands of islands, varying in size from mere rocks to areas hundreds of square miles in extent. A general survey of the geological conditions shows that drift is sparingly distributed. According to vegetation the following types of islands were noted: (1) floating bog islands, (2) Scirpus and Phragmites islands, (3) sand dune islands, (4) irregular creviced-rock islands, (5) dome-shaped rock islands, with or without drift sheets.

The strand flora was discussed as (1) beach formation and (2) shore formation. In the beach three areas or zones of distribution were defined: (*a*) front strand, (*b*) mid strand, (*c*) back strand. Strand pools with concentric zones of vegetation were described as a feature of mid strand. Three types of strand vegetation in general were defined: (*a*) Cornus strand, (*b*) Salix strand, (*c*) Prunus strand. A discussion of the conditions under which beach formations arose was given, with reference to drift distribution and wave action.

The shore formations were discussed briefly, attention being given to surf plants, such as Scirpus, Phragmites, and Spiræa salicifolia. Gullies crossing a strand or shore, and the change in the distribution of shore plants consequent upon their existence, were described in outline.

It was shown that the islands with rock cones could be classified either as irregular or as dome shaped. The latter showed a remarkable zonal distribution of plants due to gradual soil-formation and the silting off of the soil in a regular way towards

[1] In almost every case the abstracts given have been prepared by the authors.

the periphery of the islands. The following zones were described from periphery to center: (1) shore zone, (2) outer shrub, (3) tree zone, (4) inner shrub, (5) central meadow or central shrub In islands in which the soil formation was recent the zonal distribution was shown to be distinct, but in older soiled islands, where the soil had become thick, it was shown that the central meadow at first becomes a central shrub and, finally, with the addition of further soil layers, a central tree formation is developed. Zonal distribution is still evident in islands with thick soil sheets, for the peripheral tree formation is made up of older individuals than occur at the center of the island. If, however, the rock surface is very irregular, this zonal distribution cannot appear, and the island in such a case is commonly clothed with a pretty uniform coniferous formation.

It was shown that after burning off an island zonal distribution will reappear in the new plants established only when the soil is thin; when it is thick the whole island is uniformly tenanted by light seeded species such as willows, poplars, and epilobiums.

The two basal forms of islands, the irregular and the dome-shaped, may be considered as combining and forming the variously shaped larger islands of the region. All islands can be explained in terms of these. Slope, contour, strike, and bedding of country rock, disposition of talus masses, direction and width of crevices, and formation of gullies, were discussed as influencing the general distribution of the plants, and attention was directed to the influence upon vegetation by proximate islands which modulated the wave action upon a given shore.

Zonal distribution on land is quite as evident in these areas as is the zonal distribution in lakes described by Mangin and others.

The paper was illustrated by numerous lantern slides.

N. L. Britton: *An Eleocharis new to North America.*—In the Alaskan collections of Thomas Howell an Eleocharis was found which proves to be a species hitherto known from Japan. It is remarkable for its very large tubercle, which exceeds the

achene itself in length and breadth. In this regard it resembles the one or two large tubercled North American species already known, but it belongs to a different section of the genus, and its other American associates show no such character. It was suggested that the function of such tubercles (enlarged style bases) may be to give buoyancy to the achene in water.

GEORGE F. ATKINSON: *Some problems in sporophyll transformation among dimorphic ferns.*—In *Onoclea sensibilis*, the sensitive fern, abnormal spore-bearing leaves are sometimes found. This form is intermediate in character between the fertile and sterile leaves of the normal form of the species, and has been regarded at different periods as a distinct species, a variety, or an abnormal state caused by the contraction of the vegetative leaf. Experimental evidence shows that the form is produced by an unfolding and extension of the young sporophyll before its characters as such are fully determined, and is caused by a complete or partial loss of the vegetative leaves through injury. Cutting off the vegetative leaves in May and again in June resulted in a large number of these abnormal forms, together with examples of apospory. These results were briefly reported at the Brooklyn meeting of the A. A. A. S. in 1894.

The experiments were continued in 1895 on another species of the genus, *Onoclea Struthiopteris*, with identical results in the transformation of the sporophyll, though no cases of apospory were observed. During the same year experiments were begun on *Osmunda cinnamomea*, but as the fertile leaf has the sporangia formed in the autumn, and since they appear along with the sterile leaves in early spring, no results were obtained that season. During 1896 there were a few cases of partial sporophyll transformation, but the results were not marked since the injury to the vegetative leaves was introduced while they were very young and long before the incipient development of the sporophyll of the succeeding year. In 1896 the vegetative leaves were cut in July and again in August, and marked results will be looked for the coming year.

A peculiar transformation sometimes occurs in this same species, which gives rise to the form *Osmunda cinnamomea frondosa*. My attention was first called to this by Mr. C. D. McLouth of Muskegon, Mich., who has furnished me with considerable material. The transformation is peculiar, in that it appears to be an increase in the leaf surface along the mid-vein of the sporophyll, and also along the mid-vein of the pinnæ, so that the sporangia are borne on wing-like expansions. The locality where these forms were collected gave evidence of a fire, either in the late autumn or early spring, and the forms were very marked and abundant near dead stumps where the fire was the hottest. Since at this season of the year the sporangia are nearly all formed, the nature of the transformation would be different from what it would be if the vegetative leaves were destroyed during midsummer, when the sporophyll was in the incipient stages of development. It is also possible that the heat penetrated far into the stem of the plant and may have introduced disturbing factors of quite a different nature from that of the loss of the carbon assimilating members, which results when the leaves only are cut away.

Experiments at different seasons will be conducted in the hope of arriving at the fundamental laws operating in these cases. A large number of lantern slides made from photographs illustrated the paper.

L. H. BAILEY: *The philosophy of species making.*—This paper will be published in full in an early number of the BOTANICAL GAZETTE.

SECTION G OF THE A. A. A. S.

D. T. MACDOUGAL: *The relation of the growth of leaves to the CO_2 of the air.*—The leaves of seedlings accomplish a large proportion of their development but not always their entire development at the expense of food derived from the seed. Rapidly developing but small leaves furnished with large stores of reserve food are able to carry out a complete development, but are

unable to endure continued existence in an atmosphere free from CO_2. The slowly developing leaves of many woody perennials develop normally and endure long continued existence under the above circumstances. This varying reaction of leaves is dependent upon a series of conditions which may be included under the title of "availability of the food supply." The death of a leaf in an atmosphere free from CO_2 is due to insufficient nutrition, and not to the pathological effects of disintegrated chlorophyll.

R. N. DAY: *The forces determining the positions of leaves.*—Epinasty and hyponasty are inherent properties of leaves, whose reactions may be suppressed but not altered by external conditions. Dorsiventral leaves are diaheliotropic, diageotropic, or apogeotropic, epinastic or hyponastic. The predominating force in every instance is the heliotropic tendency, which suppressed other reactions. The position of the leaf is a physiological, not a mechanical, resultant, and cannot be expressed by the parallelogram of forces as proposed by Krabbe in 1889.

N. L. BRITTON: *On Cratægus coccinea and its segregates.*—The necessity of observing living forms in various stages of growth was pointed out. Typical *C. coccinea* is known by its cordate leaves, moderately glandular inflorescence, etc. Occurring with it, and lost sight of, has been *C. rotundifolia*, with smaller oval or oblong leaves narrowed at base, larger flowers, a densely glandular inflorescence, and a different time of blooming. Other segregates are *C. flabellata*, a northeastern species, with leaves narrowed at base and more incised; *C. macracantha*, the species with smallest fruit; and *C. mollis*.

L. M. UNDERWOOD and F. S. EARLE: *The distribution of the species of Gymnosporangium in the south.*—This paper appears in full in this number of the BOTANICAL GAZETTE.

L. H. BAILEY: *Morphology of the Canna flower.*—The author called attention to the prevailing asymmetry in the Scitamineæ,

and remarked that groups of plants which show marked irregularities in form are nearly always fertile subjects for plant-breeding. The most nearly symmetrical flowers of this order are found in the banana tribe, in which five stamens are present and the sixth is represented by a sterile filament. He exhibited a banana fruit to show its five-angled form, and remarked that it is probable that somewhere in its phylogeny this fruit had lost its symmetry. He also called attention to the three seedless loculi of the fruit, and remarked that although the plant is seedless, it still varies or it is the subject of evolution, thus discrediting Weismann's hypothesis that all progressive or permanent variation arises through sexual union.

In the ginger tribe the stamen is reduced to one normal member. In the canna tribe the stamen is represented by what is apparently but a single loculus of the anther, the other loculus being apparently developed into a foliaceous organ. The remaining stamens are represented by petal-like staminodia and these members make up the showy part of the flower. The speaker exhibited specimens of canna flowers, and also charts, to show the very marked evolution in the form and size of the flower, and more especially of the staminodia, and the gradual increase in the size of the petal-like appendage of the one fertile stamen. There seems to be a considerable decrease in seed production in the modern cannas as compared with the types of a generation and more ago, and this decrease is probably associated with less pollen, or less efficient pollen, in the modern flowers. This tendency toward seedlessness is seen in many cultivated plants, of which the potato is a good example. Since new varieties come mostly from seeds, many persons have supposed that plant-breeding must eventually cease in these plants ; but the speaker pointed out that the constant choice of seeds for sowing is itself a powerful agent in conserving the seed-producing power of the plant. So long as we select seeds, so long may we expect the effects of this selection to give seeds in at least a part of the individuals of every generation.

E. L. MOSELY: *A comparison of the flora of Erie county, Ohio, with that of Erie county, N. Y.*—Both districts are adjacent to Lake Erie, but the Ohio district (including Erie county and the peninsula and islands of Ottawa county) contains 265 native species of phanerogams not known to occur within fifty miles of Buffalo. The cause is mainly climatic. The average date of the last killing frost in spring at Sandusky is April 30, at Buffalo it is May 20; the first killing frost in autumn at Buffalo is September 15; at Sandusky it is October 24; and the summer is decidedly cooler at Buffalo. Reasons for the difference in climate were given, including the blowing of the ice to the east end of the lake in spring and other considerations.

CHARLES E. BESSEY: *The significance of the compound ovary.*—In the study of the gynœcium of angiosperms we are forced to conclude that its primitive condition was apocarpous; in other words, that whether monocarpic or polycarpic there was at least no union of ovary with ovary. The original ovary was doubtless simple. By a comparative study of the ovaries of existing plants we are led to the conclusion that the syncarpous gynœcium was derived from the apocarpous gynœcium. This is so plain that it is needless to dwell upon it. Both phylogenesis and ontogenesis furnish us with numerous illustrations of the truth of this statement.

It is to be observed that the compound ovary is a comparatively stable structure, and that it changes slowly within any natural group, or in passing from group to group. No part of the plant is more stable, yet with all its stability it undergoes changes in certain directions. It is a common occurrence to find a pentacarpellary ovary reduced to four, three, or two carpels, and this may proceed until, as in some of the Caryophyllaceæ, we seem to have but one carpel remaining. In rare cases there appears to be a reversion from syncarpy towards apocarpy, as in the Apocynaceæ and Asclepiadaceæ, but as a rule it may be said that syncarpy once attained by a group is persistently maintained, however much of simplification it may otherwise have undergone.

The ultimate development of the compound ovary is in the direction of a simplification of structure. Thus the many carpels of most Thalamifloræ and Heteromeræ are gradually reduced to the two carpels of the Bicarpellatæ. In the Calycifloræ the Rosales and Myrtales have generally several to many carpels, while in the Umbellales there are but two. Likewise in Inferæ the ovary in the lower group, Rubiales, has more carpels than we find in the highest group, Asterales. A similar simplification occurs in the monocotyledons, as we pass from the Coronarieæ to the sedges and grasses. This simplification of structure results in increased paternal care of the offspring. Thus while many embryos are to be nourished in the earlier cases, there are but one or two in the later. The biological significance of this result is so well known as to need no discussion here.

When we come to an application of what we know of the compound ovary to systematic botany, it appears to me that the following conclusions are warranted: (*a*) the apocarpous plants are to be regarded as lower than those which are syncarpous, and in a natural arrangement the former must precede the latter; (*b*) we must carefully distinguish between ovaries which are primitively simple, and those which have become simplified from a more complex structure, in which cases the first indicate a lower, and the second a higher position in the natural system; (*c*) grasses, sedges, etc., in which the ovaries are simplified from the compound type, are not the lowest of the monocotyledons; (*d*) willows, oaks, walnuts, etc., with their apparently simple flower structure, are not to be regarded as among the lowest of the dicotyledons.

H. L. Russell: *On the bacterial flora of cheddar cheese.*— The paper presented a quantitative delimitation of the bacteria in cheddar cheese from the time it is first made until it has been thoroughly broken down. The botanical changes are divided into three stages, as follows: (1) period of initial bacterial decline, (2) period of bacterial increase, (3) period of final decline. As

to changes in different species it is found that the lactic acid bacteria develop to an overwhelming degree while the gas bacteria and the peptonizing germs are gradually destroyed.

CHARLES R. BARNES: *Terminology of reproduction and reproductive organs.*—Two points were discussed, which are not directly related:

(1) The distinction between vegetative and non-sexual reproduction. The reproduction of the earliest plants was undoubtedly vegetative reproduction. Non-sexual reproduction is not fairly differentiated from it until the Bryophyta are reached, and with them a clear alternation of generations. In Bryophyta, Pteridophyta, and Spermatophyta, the forms of vegetative reproduction, viz., by brood buds or gemmæ, by detached shoots, and by proliferation (with detachment late when it occurs at all) are clearly distinguishable from the non-sexual form, viz., by spores produced in a compound sporangium. The fundamental distinction lies in this, that vegetative reproduction *repeats the same phase*, while non-sexual reproduction *gives rise to the alternate phase*.

(2) The classification of sporangia and gametangia into *simple* and *compound* was suggested. The simple gametangium or sporangium is one consisting of a single cell whose contents become respectively the gametes or the spores. The compound gametangium or sporangium is an aggregate of several or many (rarely reduced to one) simple gametangia or sporangia surrounded by one or more layers of sterile protective cells. Oogonia and carpogonia are simple gametangia, archegonia are compound gametangia. Simple sporangia occur below Bryophyta; compound in Bryophyta and above.

BERTHA STONEMAN: *A comparative study of the development of some anthracnoses in artificial cultures.*—Different species of Glæosporium and Colletotrichum, and the allied genera Vermicularia and Volutella, present in artificial cultures distinct characters varying to a certain extent with varying conditions of light, temperature, and nutrient media. Under uniform conditions of

growth the characters have been found sufficiently constant to be of value in distinguishing or uniting species whose similarity in morphological structure or variations resulting from the character of the host would render their systematic position uncertain. Of about thirty species studied, five Colletotrichums and two Glœosporiums have been definitely connected with an ascigerous form, the transition from one stage to the other occurring without the intervention of a pycnidial stage. The ascigerous stages of each, two of which have been found as saprophytes in nature, bear a close resemblance to each other and would fall in a genus near Gnomoniella.

W. W. ROWLEE: *The development of the vascular elements in the primary root of Indian corn.*— In many text-books the large cells in the central portion of the root-tip are described as the rows of cells from which the vessels are developed.

Investigations prove that these larger cells pass over into parenchyma and that the protoxylem is differentiated from cells radially opposite and nearer the surface than these.

JOHN M. COULTER: *Some remarks on chalazogamy.*—The use of chalazogamy as a basis of classification was first discussed, reasons against such use being the unnatural associations and separations, the use of a single character for important groupings, the fact that chalazogamy has to do not with a differentiated organ but with a process. The use of chalazogamy as an indication of phylogeny, as suggested by Nawaschin, was also discussed, the view that it is an intermediate stage in the adaptation of a gymnosperm-trained pollen-tube to the traversing of angiosperm cavities being objected to. It was shown that the necessity of "adaptation to cavities" was by no means so great as generally supposed, and that chalazogamy is more suggestive of being an occasional modification of porogamy than an antecedent condition. In regard to the significance of chalazogamy the speaker claimed that it is purely physiological, and does not involve any such change in structure as will define a natural group

or indicate a line of descent. The route of the pollen-tube is dependent upon mechanical obstruction, nutritive material, possibly chemiotaxis, and this route may or may not include the micropyle, quite independent of plant affinities. Illustrations were given showing that chalazogamy is favored by a closed micropyle region, and by unfavorable position of the micropyle associated with favorable structure of the ovule, such as well-developed sterile macrospores.

L. M. UNDERWOOD: *The habitats of the rarer ferns of Alabama.*—The state of Alabama is especially interesting to the students of the pteridophytes (1) from the fact that it represents the southern limit of a number of species of the Appalachian district which follow the spurs of the mountains well into the interior of the state, and on the other hand the northern limit of several of our subtropical species; (2) because of the remarkable *Trichomanes Petersii* found only within its borders; and (3) because it contains the only station where the rare *Asplenium ebenoides* has been found in any quantity. The state has a comparatively large pteridophyte flora, including some forty species of ferns besides at least five species of Ophioglossaceæ, having been well explored by Judge Peters, Professor E. A. Smith, and Dr. Charles Mohr. We have been able to add one species (*Dryopteris Floridana*) to the list, and to rehabilitate one of the early species of Botrychium, *B. bipinnata* (Lam.), which is clearly distinct from *B. ternatum*, with which it has been confused for many years, largely because of the deficiency of collectors through the southern country.

A visit to the original station of *Trichomanes Petersii* has given some new points in regard to its habit and habitat. Likewise a visit to the out-of-the-way ravine in Hale county has enabled us to show the absurdity of regarding the rare *Asplenium ebenoides* as a hybrid. This species, far from possessing the habit of either of its supposed parents, is entirely distinct, and is more closely allied in its habit to its congeners, *A. pinnatifidum* and *A. montanum*. It is evidently a very old species, of which the pres-

ent station doubtless contains the largest remnant of its former wide distribution.

FRANCIS RAMALEY: *On the stem anatomy of certain Onagraceæ.*— Seven genera of the disintegrated genus Œnothera, represented by thirteen species, were examined, with the following conclusions. There seem to be no marked anatomical characters of the stem which can be set down as belonging to one species and to no other. Plants of the same species growing under different conditions may present as great differences as are to be noted between species of comparatively remote genera. Slight differences in the thickness of the various zones of tissue are evident, as are also variations in the size of the constituent elements in some of the tissues. The following generalizations may be drawn: (1) there is a striking similarity in stem structures throughout all the genera examined, and stem anatomy will not serve to distinguish one genus from another; (2) the cortex is absent from old stems, being replaced by cork of characteristic structure; (3) the normal phloem is in all cases poorly developed; (4) bicollateral vascular bundles occur in all the species examined; (5) intra-xylar phloem islands are found in the stems of all the robust species; (6) raphides of calcium oxalate are present in all cases, generally occurring in both cortex and pith, often in the pericycle and phloem.

CHARLES E. BESSEY: *The point of divergence of monocotyledons and dicotyledons.*— In discussing this question I assume that it is unnecessary to bring forward proofs as to the common origin of the two subclasses, Monocotyledonæ and Dicotyledonæ. It is possible, but in my opinion improbable, that some plants are now included in them which have had an independent origin, but all will agree that after making the most liberal subtractions possible the two subclasses must still remain as two very closely related groups, with essentially the characters now assigned to them. We must bear in mind the well-known biological law that, in general, the relationship of allied groups is most marked between their lower members, that is, between those members

which represent the primitive types, and that it is less marked between the higher members of the groups. In other words, we recognize the fact that groups diverge as they are evolved. If we represent the phylogenesis of plants by lines, we are compelled to arrange these lines so that they show repeated series of divergencies.

Another law which must be kept in mind, also, is that evolution for the most part has proceeded from the simple to the complex. The simpler plants of today represent to a large extent the types of the primitive plants of former periods, from which the complex plants of today were derived. In this connection, however, we must not overlook the fact, as pointed out elsewhere,[2] that in the evolution of the successive members of groups of plants there has often been a simplification of structure. Thus we often find apetalous derivatives from polypetalous types; bicarpellary ovaries from polycarpellary types; one-celled, one-seeded compound ovaries from several-celled, many-seeded ovaries. But there is a great difference between these simplified structures which have been derived from more complex structures, and those which are primitively simple. The former are nearer the end of a lengthened genetic line, the latter are nearer its beginning.

When we apply these principles to the system of Bentham and Hooker we find no contact points whatever between monocotyledons and dicotyledons. The lower monocotyledons are very unlike any of the Apetalæ. What similarity, for example, is there between the grasses and sedges, on the one hand, and the oaks, walnuts, and plane trees, on the other. It is only when we pass up to the Apocarpæ in the monocotyledons and to the Micrembryeæ, and possibly Piperaceæ of the latter, that there are many similarities of structure. To this I must refer later, and need only say here that evidently the authors made no attempt to indicate by their arrangement of families any contact point between the monocotyledons and dicotyledons.

[2] Evolution and Classification. Proc. A. A. A. S. **42**: 237. 1894, and The significance of the compound ovary, presented at this meeting.

In the system of Engler and Prantl one might look for such a disposition of the families of the two subclasses as to indicate a common point of origin, but in this we are disappointed When we compare the structure of the families placed at the beginning of the monocotyledons, Typhaceæ, Pandanaceæ, Sparganiaceæ, Potamogetonaceæ, Naiadaceæ, Aponogetonaceæ, Alismaceæ, etc., with those occupying a similar place in the dicotyledons, Saururaceæ, Piperaceæ, Chloranthaceæ, Lacistemaceæ, Juglandaceæ, Myricaceæ, Leitneriaceæ, Salicaceæ, etc., it is at once evident that here there is a great gulf between the two subclasses. It is becoming more and more evident that this system which promised so much is little better as an expression of genetic relationship than the system of Bentham and Hooker, which it is now displacing. Its so-called lower families are for the most part composed of plants not with a simple, that is, a primitive structure, but a simplified structure. As a rational system, designed to express our ideas of genetic relationship, it is sadly disappointing.

It is evident that we must cease to confuse the simplified with the primitively simple structures, and that in the latter alone can we find the point of divergence of the plants of the two subclasses under consideration. It is only when we do this that we are able to construct a system which shall suggest to us the solution of the problem. Our system must begin with simple pistils, not compound pistils; with really simple and not simplified pistils. It matters little whether the flowers are perfect or not; whether they have many or few flower-leaves or even none at all. We have learned that these are minor matters and that they change very readily even within narrow limits.

In accordance with these principles we may readily fix upon the apocarpous monocotyledons (Bentham and Hooker's Apocarpæ) as the representatives of the primitive members of this subclass. This structure will readily suggest the Ranales among the thalamifloral dicotyledons, and a closer examination shows a remarkable similarity of structure, in not only the reproductive but also in the vegetative organs of the plants of these two

groups. After some years of study given to a comparison of these groups I am more firmly convinced than ever of their genetic relationship. They show their relationship in their gross anatomy, the histology of their tissues, and their embryology.

Allied to the Ranales are the Rosales, beginning with the Ranunculus-like Potentilleæ, and passing by easy steps to the simpler Leguminosæ (Cæsalpiniaceæ and Mimosaceæ), on the one hand, and the Saxifragaceæ on the other, and through the latter to Celastrales and Myrtales. Here, then, in my opinion, is the point of divergence of the monocotyledons and dicotyledons, represented by the Apocarpæ of the former, and the Ranales and Rosales of the latter. The similarities in structure between some Microspermæ and the Naiadaceæ in Bentham and Hooker's system, noticed above, as between some of the families (Naiadaceæ, Alismaceæ, Chloranthaceæ, etc.) placed by Engler and Prantl at the beginning of the two subclasses, are hints as to a natural arrangement which it is strange that these eminent systematists overlooked.

L. M. UNDERWOOD and F. S. EARLE: *Notes on the pine inhabiting species of Peridermium.*—The paper gave an enumeration of the species known to inhabit the various species of Pinus in the United States, with their distribution by hosts, and their geographical distribution. All the species are foliicolous except *P. cerebrum* Pk., which forms large distortions on the stems, trunks, and branches of its hosts. Remarks were made in reference to the various forms of these distortions, especially those produced in the south on *Pinus Tæda* and *P. echinata*. The species being perennial, the necessity of an alternate stage for the parasite is obviated.

D. T. MACDOUGAL: *Reaction of leaves to continuous rainfall.*—The first recognition of the influence of rainfall upon leaf forms was that given by Ridley in his *Flora of Pajang*, and an extensive exploitation of the subject was made by Stahl in 1893. Since the publication of Stahl's work, Jungner has carried on a

great amount of observational work of doubtful value, and has made some attempts to produce rainfall characters in leaves experimentally. The hitherto recognized rainfall characters are as follows: attenuated apices, entire margins, a glossy appearance of the upper surface, ready adhesion of water to the upper surface, deepened furrows above the ribs, pendent positions of the laminæ, and enlargement of the pulvini. It is to be noted, of course, that in no one species do all of the above characters appear, and Jungner has been able to induce only the glossy appearance, adhesion of the upper surface to water, and the pendent position of the laminæ in a few of the many species tested.

During the past year I have carried out such a series of experiments with *Arisæma triphyllum*, *Trillium erectum*, and *T. recurvatum*. In the trilliums the pendent positions of the laminæ, the glossy appearance of the upper surface, and a reduction of the marginal teeth were obtained. In Arisæma, the glossy appearance, adhesion to water of the upper surface, a marked reduction of the truncate marginal teeth, and a deepening of the furrows above the ribs were obtained, and, in addition, the laminæ of this species assumed an upwardly convex form after exposure to rainfall continuously for twelve days. This must be considered as a new rainfall character, and is not to be identified with the rolling and twisting of leaves grown in a spray of cold water. In an attempt to distinguish the characters to which the glossy surface was due, it was found that in the normal leaf the external ends presented an outwardly papillose extension, giving a velvety appearance. In the rainfall leaves the outer wall of each cell was distinctly flattened. The smoothness of the upper surface is doubtless the principal factor in its adhesion to water, though it is entirely possible that chemical alterations in the outer wall have ensued. The results may be summarized as follows: (1) the determination of a new rainfall character, the upward convexity of the laminæ; (2) alterations in leaf margins; (3) inferentially, that the rainfall characters which may be induced experimentally are not identical, but rest upon the individuality of the species.

MARY A. NICHOLS: *Studies in the development of the ascospores in certain Pyrenomycetes.*—The paper contained an account of the early stages in the development of the ascigerous fruit in certain spheriaceous Pyrenomycetes. The observations relate specially to the question of sexuality, and point to the conclusion that a sexual process may be present in some member of the family and absent or very degenerate in others. Thus, in *Ceratostoma brevirostre* the origin of the ascospore is distinctly traceable to a fusion of differentiated gametes, while in Teichospora only possible rudiments of antheridia are present. The successive stages from the formation of the oosphere to the maturation of the ascospore reveal a process of development somewhat different from any heretofore suggested, but analogous to the development in Sphærotheca, as observed by Harper, and also somewhat similar to that in the Florideæ.

W. W. ROWLEE: *The stigma and pollen of Arisæma.*—The paper described the androecium and gynœcium of *Arisæma triphyllum* and *A. Dracontium.* The peculiarities noted were the consolidation of the stamens, the open style with the stigmatic papillæ not only on the surface of the stigma but also on the inner surface of the tube and forming a stigma-like tuft on the inner surface of the ovary. The pollen in one case was found to have already germinated within the anthers, and the tubes had folded back and forth upon themselves. Other cases examined did not show the same growth.

N. L. BRITTON: *Notes on the genus Amelanchier.*—Among the eastern forms, *A. Canadensis* can be distinguished easily from the rest, and is Appalachian and Canadian in distribution; *A. Canadensis obovalis* belongs to the coast and Great Lakes; *A. spicata* is a very low mountain species; and *A. rotundifolia* extends from Maine to the Saskatchewan. Among the western forms, *A. alnifolia* is reported from northern Michigan, but its occurrence so far east is doubtful, its eastern limit being rather from Nebraska to Manitoba; *A. Utahensis* ranges from Utah to

Arizona; *A. florida* occurs in Oregon and Washington; and *A. Pringlei* in Mexico.

ALEX. P. ANDERSON: *On the formation and distribution of abnormal resin ducts in conifers.*—By some extended work on the occurrence of normal and abnormal resin ducts in conifers the author found: (1) annual rings of *Pinus silvestris* and *Picea excelsa* containing frost rings have in cross sections fewer vertical resin ducts per square millimeter than the normal rings; (2) regulatory tissue in hyponastic branches of *Pinus silvestris* has in cross sections fewer resin ducts per square millimeter than the opposite side of the branch; (3) in *Abies pectinata* affected with *Æcidium elatinum*, (*a*) the resin ducts in the diseased bud-scales are more irregular in their form and contain fewer epithelium cells than the normal, (*b*) the fungus mycelium is never found in the resin duct canals, nor in the epithelium layer of cells surrounding the canals, (*c*) abnormal resin ducts are always found in the wood of the thickened portion of the diseased branch; (4) in *Pinus Strobus* diseased at the roots with *Agaricus melleus* Vahl, an increase in the number of resin ducts of the wood takes place in the whole plant above the diseased part; (5) in the wood of branches of *Abies pectinata* diseased with *Phoma abietina* Hartig abnormal resin ducts are found only above the constricted portion of the branch; (6) the same phenomenon as just mentioned occurs when young seedlings of *Abies pectinata* are diseased with *Pestalozzia Hartigii* Tub.

ARMA A. SMITH: *The development of the cystocarp of Griffithsia Bornetiana.*—Published in full in the July number of the BOTANICAL GAZETTE.

L. M. UNDERWOOD: *Notes on the allies of the sessile Trillium.*—Several species of Trillium have been confused apparently under this name. Even Linnæus included under this name at least two species which had been well figured before his day, the one by Plukenet and the other by Mark Catesby. One of these

species, which is very distinct from the ordinary *T. sessile* in the states bordering the Ohio river, has been collected and studied in central Alabama during the past spring. It is a robust species with highly variegated leaves of at least three striking and distinct shades, and is well worthy of cultivation for its rich, velvety foliage, to say nothing of its large and rather handsome red flower. The species seems to have remained since Catesby's time without a name other than the polynomial he gave it. Other southern and southwestern species, as well as an equally remarkable series of species from the Pacific coast, have been unceremoniously and unnaturally combined under this name by American botanists, or barely separated as varieties or "forms." A revision of the group is badly needed. Attention was also called to a series of forms representing the earlier stages of the plant, and the study of post-embryonic stages was urged as a means of determining relationships.

C. L. POLLARD: *On an apparently undescribed Cassia from Mississippi.* — A remarkable Cassia, allied to *C. Chamæcrista*, but distinguishable by its virgate habit and strict pods, collected in northern Mississippi by Professor S. M. Tracy, proved, upon cultivation, to warrant its separation as a distinct species, to which the author proposes to give the name of the discoverer.

B. M. DUGGAR: *A bacterial disease of the squash-bug* (*Anasa tristis*).— Some squash-bugs kept for experimental purposes were found to be dying in considerable numbers, in an apparently healthful environment. The disease was readily passed on to other bugs. The distressed insects became sluggish, and very weak, and finally died, the body becoming a mass of gruel-like fluid. Cultures were made from dead insects upon various nutrient media, agar-agar, bouillon, gelatin, milk, etc., giving colonies of a bacillus. Inoculation of this bacillus produced the disease in healthy bugs. Infusions of different cultures were found to have characteristic toxic properties. Bugs placed in these infusions died with every symptom of distress. Prepara-

tions of the blood of diseased insects showed a short bacillus, single or in pairs. The tissues of the insects break down under the growth of these organisms, which probably enter insects through the spiracles.

C. R. BARNES: *What is bark?*— The varying use of this term suggests a consideration of how it should be used by American botanists. *Borke* and *Rinde* have been used by German botanists to denote respectively the external tissues of the root or stem which dry up, and the entire mass of tissues outside the cambium. In this usage, which has been tolerably consistent, they have been followed by the English. American popular usage, and scientific usage except as modified by foreign influence, assigns the name *bark* to the *Rinde* of the Germans. But *Borke* has been translated *bark*, while *Rinde* is translated *cortex* in the English editions of various German text-books. The author advocates the use of *bark* to designate the whole mass of tissue outside the cambium, while *cortex*, with suitable qualification, is used to designate certain parts of the bark. In this usage Americans are sustained by French botanists.

JOHN M. COULTER: *Structures of the embryo-sac.* — Attention was called to recent observations which showed a certain amount of variability in these apparently constant structures. These observations were supplemented by studies in Salix and the Compositæ. The results were summed up in the form of definitions of the three embryo-sac regions as follows: (1) *the egg-apparatus* consists of two or three usually naked cells, the oosphere and one or two synergids together representing a single archegonium, of which the synergids may represent canal cells; (2) *the primary endosperm cell* is formed by the fusion of two vegetative cells (the polar cells), which process holds no relation to a sexual fusion and is stimulated normally by the act of fertilization to continue the vegetative development of the gametophyte, just as the adjacent sporophyte structures are stimulated to develop seed and fruit; (3) *the antipodal cells* are variable in number

(two to seventeen observed), evanescent or persistent, representing the vegetative region of the gametophyte not dependent upon fertilization for its development.

Embryos have been observed to develop both from synergids and in the antipodal region, and such may be regarded as arising through apogamy.

N. L. BRITTON: *Some Cyperaceæ new to North America, with remarks on other species.—Cyperus cylindrostachyus*, of the Old World tropics, has been introduced into the southern states, and is *C. cylindraceus* Chapman; *C. thyrsiflorus*, a Mexican type, extends into southern California; the Asiatic *C. pumilus* has been found introduced into Florida and Alabama. As waifs may be mentioned the Asiatic *C. congestus*, found at Painesville, Ohio; *C. glaber*, of southern Europe, found in Massachusetts; and *C. comosus*, of Greece and the Levant, found on ore heaps at South Bethlehem, Penn. The Cuban *Scirpus camptotrichus* has been found by Dr. Mohr as a native plant near Mobile. The author has also satisfied himself that the African *C. aristatus* is not the American plant so often bearing that name, and that the latter should retain its old name *C. inflexus*.

L. H. PAMMEL: *Grasses of Iowa.*—The paper contained a description of the topography of the state, and presented a list of the grasses. The grass flora is not diversified, containing fewer species than are to be found in any adjacent state. Among the species are noted twenty-nine species as from the north, forty-six from the south, eleven from the west, thirteen extra-continental, and fifty-five introduced.

W. A. KELLERMAN: *Ceres-pulver: Jensen's new fungicide for the treatment of smut.*—In 1890 Kellerman and Swingle published an account of successful experiments with potassium sulfid (liver of sulfur) as a preventive of smut of wheat and oats. This, according to J. L. Jensen, was the starting-point (*Ausgangspunkt*) for his *Ceres-pulver*. The exact composition of the

fungicide is not given but it consists mainly of potassium sulfid. Other important ingredients are, according to Jensen, also added. He manufactures the ingredients and they are doubtless of purity superior to those usually kept in drug stores, and probably not too expensive, considering the quality.

The method of application is wholly different from that employed by myself and Mr. Swingle. I can, after trial, highly recommend it. A solution is made by dissolving 2 lbs. in 125 liters of water. This is intended for 1000 lbs. of seed. It is poured on the seed grain by means of an ordinary watering can, the mass at the same time being shoveled over and over on a tight floor, so that the solution may come in contact with every grain.

The stirring of the heap of grain is repeated twice daily, the sowing to be done four or five days after the treatment. The heating will not be detrimental if the mass of grain is not more than six or eight inches deep. The initial stages of germination, which will be entered upon, are claimed to be of decided advantage.

My own experiments with this fungicide, though not yet completed, show that it is remarkably efficient and that it justifies the claims made for it by the originator.

N. L. BRITTON: *On the cardamines of the C. hirsuta group.*— *C. hirsuta* was distinguished from related species and regarded as probably a native of eastern North America, and not necessarily a marsh plant. *C. Pennsylvanica* Muhl., the most common form, is a tall leafy species, with elongated leaf segments, pods narrower than in the type, and is a bog and marsh plant. *C. parviflora* L. is a rock species of the mountains, and extending west to Lake Superior. It is a slender form with narrow leaf segments, and zigzag stem. *C. flexuosa*, a mountain species, is broadly leafy, with wide leaf segments, and pedicels shorter than in *C. Pennsylvanica* and pods two to three times as broad. *C. arenicola* is a species of the sand plains, from southern New England to New Jersey, Ohio, and from the Gulf states to Texas. It is rigidly erect, with narrow leaf segments and strictly erect pods.

JOHN K. SMALL: *The relation between the genera Thysanella and Polygonella as shown by a hitherto unobserved character.*—*Thysanella fimbriata*, the only representative of the genus, has persistently and apparently without reason been referred to the genus Polygonum. Its habit and morphology does not suggest Polygonum at all but strongly resembles that of Polygonella. The floral structure in Thysanella approaches more closely the conditions we find in Polygonella than anything known to exist in the genus Polygonum.

Another character possessed by both the genera in question, and one never mentioned in this connection, is the internodal branching. In all other members of Polygonaceæ the branches arise from the nodes; in Thysanella and Polygonella the branch or branchlet, as the case may be, is united to its primary axis often to beyond the middle of the internode.

JOHN K SMALL: *An apparently undescribed species of Prunus from Connecticut.*—This species is related to *Prunus maritima* and occurs in the immediate neighborhood and under precisely the same conditions. It is lower than the beach plum, more slender and delicate in habit, maturing its fruit earlier and losing its leaves earlier in the fall. The following differences from *P. maritima* may be noted: (1) the leaf is orbicular instead of elliptic or oblong; (2) the flowers are smaller with shorter and broader calyx-segments; (3) the drupe is smaller, always globose, and short pediceled; (4) the stone is smaller and more turgid (nearly as thick as broad) and pointed only at the base, while that of the common beach plum is flattened, more elongated, and pointed at both ends.

JOHN K. SMALL: *The flora of the summits of King's mountain and Crowder's mountain, N. C.*—The following phenomena may be noted: (1) the rare fern *Asplenium Bradleyi* is very common on the slopes and extends to the higher points; (2) normally large forest trees appear as small shrubs although the altitude is not great, and in this extremely stunted state produce abundant

fruit; (3) the vegetation is shrubby with the exception of two perennial herbs, a fern and a sedge; (4) the occurrence of *Quercus nana* in the summits extends the geographic range of that species several hundred miles in an unexpected direction; (5) almost one-half of the shrubby plants on King's mountain are ericaceous, and the range of one, *Rhododendron Catawbiense*, is extended far to the east and in addition the station is at a much lower altitude than any at which the species has hitherto been known to occur; (6) although the summit of King's mountain is much smaller and some feet higher than that of Crowder's mountain it harbors six more species, chiefly shrubby.

DAVID F. DAY: *Parthenogenesis in Thalictrum Fendleri.*—In 1883 a seedling of *T. Fendleri* was sent home from Colorado for cultivation. In late May it flowered and proved to be pistillate. About the last of August it presented abundant and good seed, although no staminate plants of any species of Thalictrum were in the neighborhood. The seeds were planted and yielded abundantly staminate and pistillate plants. Staminate plants have been artificially prevented from maturing flowers almost every year since. At least eight times in the thirteen years the pistillate plants have produced good seed in abundance. Plants were sent to Meehan, Missouri Botanical Garden, and Orpet of S. Lancaster, Mass., and all report in 1896 perfect seed from pistillate plants. This seems to be a clear case of parthenogenesis. *T. dioicum* does not show a similar habit.

ELIAS J. DURAND: *A discussion of the order Pezizineæ of Schröter.*—A brief historical sketch giving the views of the principal systematists in regard to the classification of these plants, especially that of Schröter in his *Kryptogamen Flora von Schlesien.* The remainder of the paper deals with the most recent views and with a summary of investigations on the subject by the writer.

S. M. TRACY: *What should constitute a type specimen?*—The speaker called attention to the confusion existing in the use of

such terms as "duplicate of type," "co-type," "type locality," etc., and suggested that some action be taken looking towards an agreement as to what should constitute a type specimen.

F. C. NEWCOMBE: *Rheotropism and the relation of response to stimulus.*—It has been shown by Strasburger and Stahl that plasmodia of Myxomycetes grow against a gentle stream of water. Jonsson found three fungi and the roots of three phanerogams that also grew either against or with a stream of water. For this phenomenon Jonsson proposed the term *rheotropism.* As the work was left by Jonsson there was no indication of the extent of rheotropism among phanerogams, nor was it determined whether there were any negatively rheotropic, nor whether there were any indifferent roots, since the three species cited by this author were positively rheotropic.

The work which is reported in this paper has shown that among seventeen species of monocotyledons and dicotyledons studied eight are positively rheotropic and nine are indifferent or neutral. None have been found to be negatively rheotropic. Only seedlings were used.

The phenomena of rheotropism in roots are these. When seedlings are suspended with their roots dipping into water flowing with a favorable velocity, the roots, if positively rheotropic, will bend their tips, in the course of a few to several hours, directly or obliquely against the stream. Since the roots grow against the mechanical pressure of the stream and display a latent period and an after-effect, rheotropism is assumed to be a response to irritability. The stimulus for this response we can do no better at present than to call the flowing water. There may be some unwillingness to regard this as the real stimulus, seeing that the response to such a stimulus is difficult to interpret as being to the advantage of the plant. This brings up the general question of the relation of response to stimulus.

It is quite certain that there is a chain of causal mechanism between stimulus and the response which the stimulus sets in

motion. This mechanism has been developed by the reaction of the plant organ toward its environment. But it is almost certain that the mechanism may be started by other stimuli than those to which it has developed a special correspondence. If this be true we may look for responses in plants and animals that are not to their particular advantage. However this may be, the investigator is interested in all irritable responses, useful to the plant or not useful, for it is only by studying all phenomena that we may go a step farther toward solving the intricate problems of irritability.

HERMANN VON SCHRENK: *Some adaptations of shore plants to respiration.*—The paper treats about equally the following topics: (*a*) the different shore plants, classified according to proximity to water (aquatic plants are not considered); (*b*) the necessity of modified structure to meet new conditions; (*c*) the modifications thus caused in the form of water lenticels and the peculiar tissue, aerenchyma; (*d*) inconstant occurrences of the latter on many plants and reasons therefor; (*e*) discussions as to what the meaning of this power of adaptation in certain plants may be.

D. T. MACDOUGAL: *The mechanism of curvature in tendrils.*—The curvatures of tendrils in response to contact stimuli are due to contractions of the concave side. The coiling of free portions of tendrils is due to excessive growth of the convex side The two processes are entirely independent, and the second may be influenced to a minor extent only by the first.

EDWIN B. COPELAND: *A contribution to our knowledge of the relation between growth and turgor.*—The paper gives an account of the state of turgor of seedlings of *Vicia Faba*, grown at various temperatures, presented by means of a table. High turgor is present when growth is slow and *vice versa*. The turgor of *Lupinus albus*, normal, etiolated, and deprived of CO_2, is discussed. Prevention of growth is accompanied in this plant also by high

turgor and *vice versa*. The conclusion drawn is that the rapidity of growth regulated the amount of turgor, instead of growth being regulated by amount of turgor.

BOTANICAL CLUB.[3]

W. A. KELLERMAN: *Distribution of certain Ohio plants.*— With the aid of a map, attention was called to the distribution of *Phoradendron flavescens* through the southern counties, the northern limit broadly coinciding with the southern limit of the drift; of *Bignonia crucigera*, occurring only in Lawrence county, the southernmost county of the state; and of *Polypodium polypodioides*, occurring in two Ohio river counties, Adams and Hamilton.

L. R. JONES: *A method of distributing fungi in pure cultures.* —When leaves contain numerous fungi the distribution of dried material frequently leads to confusion. Cultures of the desired fungus are made in agar and sent in blocks with the dried material.

MRS. E. G. BRITTON: *An interesting moss from the White mountains.*—In a recent collection of mosses made by Mr. Faxon in the White mountains there occurred specimens of *Tetraplodon mnioides*. The moss is known in small tufts on other mountains, but occurs abundantly in the new station. Its abundance seems to be explained by the presence of the mountain stables, from which the dripping urine of the horses has furnished peculiarly favorable nutrition.

DAVID F. DAY: *The branching rhizomes of Iris.*—Numerous native species of Iris in cultivation had been observed, and in every case the rhizomes branched terminally into three divisions, the central one alone giving rise to the flowering stem. This habit is believed to be true of all American species of Iris, and of all species excepting the so-called bulbous forms.

[3] No formal papers are read before the Club, but the topics reported are presented informally and discussed.

C. E. BESSEY: *Distribution of Arctostaphylos Uva-ursi in Nebraska.*—The state was described as an almost treeless sloping plain, rising from the Missouri river at an elevation of 1000 feet to 5000 feet at the western boundary. Near the center of the state the bearberry was found a few years ago in a small cañon, and recently at a second station in a gorge of the bluffs of the Republican river at the southern boundary of the state These two isolated patches are widely separated from the present mass distribution of the species to the north and west. They are also noteworthy from the fact that ericaceous plants are notoriously absent from the whole region.

F. C. NEWCOMBE: *An improvement in a paraffin bath.*—Shrinkage of protoplasm when imbedding plant tissues often occurs when they are transferred from the cold saturated paraffin solution to pure warm paraffin. To enable one to make this increase in temperature gradual some device must be adopted to allow the imbedding dish to be lowered gradually into the bath. A brass spring bearing against the side of the pocket which receives the dish was suggested.

W. W. ROWLEE: *Notes on oaks.*—Specimens of oaks growing in the vicinity of Ithaca, N. Y., were displayed, showing (1) the habit of branching at the end of each annual growth, giving the characteristic appearance of rigidity; (2) a case of second shoot development during the present season, the winter bud having formed in June, and subsequently having developed its shoot; and (3) a remarkable case of leaf variation upon a single branch, giving the tree the appearance of bearing a branch of some other species.

C. E. BESSEY: *Distribution of Pinus ponderosa in Nebraska.*—The distribution of this pine in Nebraska has been given usually as occurring in two regions: along the northern border of the state down the Niobrara and up its cañons; and at the southwestern corner of the state along the Platte. It is now found

that the pine occurs in patches in cañons of the Loup in the center of the state, and also elsewhere, representing remnants of forests. A former extension eastward along the valleys was inferred, and their present bare condition was attributed to the destructive presence of man during the years of migration "across the plains."

L. H. JONES: *Notes on potato-leaf fungi.*—Cultures of *Macrosporium Solani* and inoculations with it indicate that it is not the cause of "early blight" or "leaf-spot disease," but is a true parasite. The cultures also proved it to be an *Alternaria*, and hence should be called *A. Solani*. What is known as "tip burn" was found to be associated with a fungus which proved not to be *M. Solani*, although usually confused with it. It produces alternaria chains, but the spores are smaller and more numerous in the chains than *M. Solani*. It is a saprophyte common to many plants and seems to be identical with *M. Tomato* Cke., which is certainly an Alternaria.

H. L. RUSSELL: *A method of hindering condensation of water in culture plates.*—Water is apt to condense upon the under surface of covers of culture plates, and dropping upon the surface of the culture plate causes more or less trouble. This can be remedied by placing the culture plate with its cover within a bowl covered by another bowl a little smaller.

C. E. BESSEY: *Notes on the flora of Colorado Springs.*—Attention was called to five distinct plant societies which occur in the region of Colorado Springs, and which abut closely upon each other with sudden transitions. The habitats of these societies are: (1) the plains; (2) open dry mountain ridges and summits; (3) deep cañons, in the lower stretches of the mountain elevation; (4) mountain meadows, at a greater elevation than the cañons; and (5) mountain swamps, usually lying between the meadows above and the cañons below. Rapid changes are taking place in the flora of the region, in explanation of which three

causes were suggested as follows: (1) removal of forests by fires, etc., thus denuding the slopes; (2) the consequent opening of cañons to light, changing dark and damp conditions to those which are open and dry; and (3) vandalism of tourists, in the cañons especially, which have been ravaged, notably of ferns.

E. J. DURAND: *On a species of Epipactis.*—Upon a lawn in the village of Canandaigua, N. Y., *Epipactis viridiflore* suddenly made its appearance, although careful search of the whole region has failed as yet to discover it as a plant of the local flora. In the same connection Mrs. E. G. Britton called attention to a similar sudden appearance of *Arisæma Dracontium* in a garden upon Staten island, although not known to occur wild anywhere upon the island.

C. L. POLLARD: *Report of the National Herbarium.*—The new organization of the herbarium consequent upon its removal to the National Museum was explained. The customary appropriation of $25,000 to the Division of Botany had been reduced by the last legislature to $15,000. The necessary relief was then obtained by an additional appropriation of $10,000 upon the condition that the herbarium be placed in the care of the Smithsonian Institution. Mr. Coville is appointed honorary curator, while the staff directly connected with the work at the National Museum consists of J. N. Rose, in charge of the determination of the higher plants and the work upon the Mexican flora; O. F. Cook, in charge of the cryptogamic work; and C. L. Pollard, in charge of the mounting and distribution of material.

E. G. BRITTON: *Note on Schizæa pusilla.*—In 1879 Mrs. Britton made the first announcement of the discovery of this rare fern in Nova Scotia. During the present season she has received additional specimens of it from Mr. Waghorne.

K. M. WIEGAND: *Notes on Boschniakia.*—Studies of Tacoma material of *B. strobilacea* revealed characters not provided for in

the generic description as it appears in the Synoptical Flora. The linear subulate bracts, and the two lateral calyx teeth are the notable discrepancies. Examination of *B. glabra*, the original species, showed that the generic description was constructed for it, and had not been modified so as to include *B. strobilacea*. Discrepancies were also pointed out in the section characters of the genus.

C. R. BARNES: *Photosyntax* vs. *photosynthesis*.— It was stated that the word photosyntax, proposed in 1893 by the speaker, but objected to by Professor MacMillan as etymologically bad, had been resubmitted to three competent Greek scholars and pronounced by all to be linguistically unobjectionable and accurately expressive of the process of carbohydrate formation as now understood.

J. F. COWELL: *Notes on some hybridized sunflowers*.— Ordinary flowers of *H. petiolaris* had been pollinated from some "doubled" *H. decapetalus*. Seedlings were shown which presented complete intermediate characters.

E. G. BRITTON: *Mnium Roellii* Broth.—The synonyms of *Bryum lucidum* E. G. Britton were explained, of which the last is *B. Sandbergii* Holzinger.

C. E. BESSEY: *The cañon flora of the plains of Nebraska*.— The cañons occurring in the general plain surface were described. Up to the very brink of these cañons sand-loving plants are found, but within the cañons they are suddenly replaced by moisture-loving plants, representing a totally different flora. The strong invasion of plants from the Rocky mountain region has, therefore, resulted in two types of incursion, that across the sandy plains, and that within the cañons. The invasion of eastern plants is observed to have a similar two-fold expression. The cañon plants are not necessarily cañon plants at the west or east, but are simply moisture-loving.

E. B. COPELAND: *Turgor variation in mosses.*—The turgor variation in relation to temperature was specially noted, being in general greater in mosses than in other groups. Plasmolysis was used as the test of turgor. It was shown that in *Mnium cuspidatum* the accommodation to changed temperature was dependent upon the products of assimilation; while in *Funaria hygrometrica* it was proved that this was not the case.

A. P. ANDERSON: *A simple piece of apparatus for infecting and spraying plants.*—A syringe of peculiar structure, such as artists use in "finishing off" paintings, was suggested, as being a better distributor than the ordinary apparatus.

E. J. DURAND: *Structure of pseudo-parenchyma.*—The method of the transformation of ordinary hyphæ into pseudo-parenchyma is easily observed in its simplest form in Tubercularia. In Peziza it is not so evident, but gradual transition can be traced clearly. In general there is a rounding off of the cells of much septate hyphæ, and sometimes a coalescence of the cells of contiguous hyphæ.

HERMANN VON SCHRENK: *Notes on the hosts of Comandra umbellata.*—This plant is by no means always a parasite, but when it is such it is assumed to be an ericaceous parasite. While most commonly attached to species of Viburnum, the speaker had found it upon *Potentilla Norvegica*, *Solidago Canadensis*, and *Phleum pratense*. Attention was called to the fact that attachment does not always mean absorption, and this is notably true in the case of a grass host.

CONWAY MACMILLAN: *Function of the submerged leaves of Salvinia.*—The hairs upon the submerged leaves have been considered usually as not organs of absorption. The speaker had observed that when exposed in water containing small crustacea, etc., the sharp-pointed hairs, standing out in every direction, are avoided. It was suggested that the hairs, therefore, may be

largely protective organs against predatory insects. They may serve also as a sort of counterpoise in high winds, offering resistance.

CONWAY MACMILLAN: *Nuclear budding in Cypripedium.*—The speaker had noted a peculiar fragmentation in the nuclei of the basal cells of the hairs. The process can be indicated best by the term "budding," as it seems to be a gradual outgrowth from the surface of the nucleus with final separation.

CONWAY MACMILLAN: *Adaptation of Coniferæ to wind-swept stations.*—In his studies of the flora of the Lake of the Woods the attention of the speaker had been called to a group of white pines which were not growing in the usual manner in rock crevices. In addition to the high branches a circle of branches flat upon the rocks had been developed, forming a dense circular mass, after the manner of a juniper. This was interpreted as an adaptation to a high wind-swept position, and shows that a forest plant may assume the juniper habit.

FLORENCE BECKWITH: *Plants new to the flora of Monroe county, N. Y.*—Since the recent publication of the Catalogue of the Rochester Academy of Science several plants new to the flora have been discovered.

EDNA M. PORTER: *Note on the pollination of Epipactis viridiflore.*—It was shown that the plant is pollinated by the wasp *Vespa diabolica.* In Europe, according to Darwin, *V. silvestris* is the pollinator. Plants covered with a netting set no seed. The observations were illustrated by an ingenious mechanical chart, *à la* Gibson.

E. B. COPELAND: *Turgor and unused residues.*—In all normal roots, stems and leaves there is a large residue of osmotically active matter which the plant cannot use to postpone starvation. In these organs the nutrient matter is relatively unimportant. In the storing places of dissolved food, however, this element

in the turgor sometimes dominates; but here, too, a considerable unused residue is usually encountered.

A. P. ANDERSON: *Supposed pathological condition of a pine board.*—The speaker displayed a board whose appearance was supposed to indicate a fungus attack, but explained that the appearance was due to the remains of the "short shoots."

EMILY GREGORY: *An interview with Schwendener.*—The speaker described an interview with Schwendener concerning the views of Reinke upon the nature of lichens, in which Schwendener is reported as saying that Reinke's views differ in no essential respect from his own.

JOHN M. COULTER: *Cross-fertilization and heterospory.*—Attention was called to the danger of confusion in applying the terms close-fertilization and cross-fertilization to heterosporous plants. Close-fertilization, strictly defined as the fusion of gametes produced upon the same individual, cannot occur in heterosporous plants. Heterospory necessitates cross-fertilization, and the closest possible affinity is that of two gametophytes borne upon the same sporophyte. In seed-plants, therefore, we find close-pollination and cross-pollination, but only cross-fertilization. The significance of the flower, therefore, is not to bring about cross-fertilization, but to render more distant the relationship between the two gametophytes concerned.

E. G. BRITTON: *The mosses of R. S. Williams.*—The speaker announced that collections of the mosses of the Columbia region of northern Montana were being made by R. S. Williams, and commended his work to the favorable attention of botanists Sets for sale will be ready soon.

W. A. KELLERMAN: *An index card for local herbaria.*—A card was exhibited upon which was printed an outline map of Ohio, which could be variously marked to indicate the range.

BRIEFER ARTICLES.

NOTES ON TWO SPECIES OF BRASSICA.

BRASSICA SINAPISTRUM Boiss. In the *Synoptical Flora*, i. pt. 1, 134, it was stated that only the smooth-fruited form of this species had been introduced into North America, such being the inference derived from the specimens examined in the preparation of that work. During the present summer, however, the writer has found a number of specimens of this species, growing on railway ballast near West Cambridge, Mass., which have hispid fruit. This form occurred in company with the more typical plant, and appeared on close comparison to differ from it in no regard other than the one mentioned. Furthermore, the pubescence of the fruit, although more or less striking when well developed, passed in other specimens into minute sparse hairs, so that transitions to the smooth-fruited forms were by no means lacking. Indeed, in some cases, the pubescence of the different siliques on the same individual differed considerably, being somewhat more conspicuous upon the lower, earlier-formed fruit. In both the smooth-fruited and hispid-fruited forms the pedicels are often hirsutulous. Both forms of fruit have long been recognized in the Old World, but the differences have been rightly regarded as formal rather than varietal.

B. JUNCEA Coss.—In May 1895, Professor Britton (*Bull. Torr. Bot. Club* **22**: 225) called attention to the frequent occurrence of this Asiatic species in waste places of southern New York, Pennsylvania to Michigan and Virginia. It had previously been found in several parts of New England, and has since proved locally abundant in eastern Massachusetts and in New Hampshire. After giving a good description of *B. juncea*, in the place cited, Professor Britton states that it is "readily distinguished from *B. Sinapistrum* Boiss. by the total absence of the hispid pubescence of that species and by its erect longer subulate-beaked pods." Having had this summer excellent opportunities of comparing many dozen specimens of each of these species growing side by side, the writer would suggest that the distinctive characters

here brought forward are by no means the most reliable. For the hispid pubescence is not always absent upon *B. juncea*, although always much less conspicuous than in *B. Sinapistrum;* the trichomes, when present, being confined to the lower leaves and lower part of the stem. Furthermore, the siliques of *B. Sinapistrum* vary greatly in position, being sometimes subappressed and sometimes widely spreading, so that they are accordingly either erect or very oblique. As to the length of the fruit there is no great difference between the two species, but if a distinction can be made on this feature it would seem that the fruit of *B. Sinapistrum* rather than of *B. juncea* was in general the longer.

On the other hand, several characters furnish very definite and constant differences. In the first place, *B. juncea* is a taller and much paler plant, having a distinctly glaucous stem and more or less glaucescent leaves, while *B. Sinapistrum*, at least as it occurs about Boston, is never glaucous at all. Then in *B. Sinapistrum* the upper leaves are broadest near the rather abruptly contracted base, while in *B. juncea* they are gradually cuneate at the base. But perhaps the most striking difference is in the fruiting pedicels, which in *B. Sinapistrum* are short and thick, being only about 4 or rarely 6^{mm} long, while in *B. juncea* they are much more slender and 6 to 10^{mm} in length. The beak of the fruit in *B. juncea* is slender, subulate, and apparently always empty. In *B. Sinapistrum*, on the other hand, it is rather stout, decidedly ancipital, and commonly contains one seed.

By these characters the plants in question can be readily distinguished, and when once recognized are not likely again to be confused. *B. juncea* seems already to be the commoner species of the two about Boston. Its rapid distribution and establishment in the United States recalls that of *Lactuca Scariola*, or the more recently disseminated *Sisymbrium altissimum*. The best illustration of *B. juncea* is that of Duthie and Fuller in their *Field and Garden Crops of the Northwestern Provinces and Oudh* (plate 41).—B. L. ROBINSON, *Harvard University*.

A NEW MAMILLARIA.

Mamillaria Brownii,[1] n. sp. Glaucous, globose, 5 to 8^{cm} high, simple: tubercles 20 to 28^{mm} long, at first terete but later becoming more or less quadrangular at base, very broad and large, the

[1] This plant will be *Cactus Brownii* to those who prefer the generic name *Cactus*

groove absent in young plants, but extending to the axil of the floriferous tubercle: radial spines 8 to 11, teretish, bulbous at base, spreading, 15 to 20^{mm} long, white or more or less tinted with purple, straight or slightly curved, lower spine and 1 to 3 slender upper ones a little farther back on tubercle than the remaining 7, which are very robust and form an almost perfect circle around the

stout central; central somewhat longer than radials and sometimes slightly flattened on upper side, always solitary and curved or hooked downward; all with horny tips: flowers 5 to 6^{cm} long and spreading to nearly same diameter, opening in bright sunshine and enduring for only a few hours, salmon-yellow: ovary tubular, 20 to 25^{mm} long, with from 4 to 7 minute, caducous scales; fruit and seeds unknown.—Type growing in cactus garden, University of Arizona.

Description drawn from plant collected three years ago by Herbert Brown, in the Baboquabari Mountains, in Southern Arizona, and which now flowers for the first time.

I have named this species for Mr. Herbert Brown, from whom the specimen was obtained. There has been some hesitation as to placing this plant in the genus Mamillaria or Echinocactus. Together with *Mamillaria macromeris* and *Echinocactus Simpsoni* this plant almost, if

not completely, breaks down all generic differences between these two genera. The prominent tubercles in no definite arrangement and the deep groove extending almost if not quite to the axil would denote it to be a Mamillaria; on the other hand, the exceedingly robust spines and the scales on the ovary are characteristic of the genus Echinocactus. It seems, however, to agree more closely with the genus Mamillaria as at present understood.—J. W. TOUMEY, *University of Arizona.*

THE DISTRIBUTION OF THE SPECIES OF GYMNOSPORANGIUM IN THE SOUTH.

IT is a somewhat remarkable fact that no less than six very distinct species of Gymnosporangium are parasitic on *Juniperus Virginiana*. These species are all found in the states bordering on the Gulf of Mexico, and so far as present data indicate, two of them are peculiar to this region. The other species are of much wider distribution, but we still lack reliable information regarding the extent of range of any of the species of the genus. The species may be arranged in groups as follows:

Producing somewhat globose galls.
  Perennial species.
    Gymnosporangium globosum Farlow.
    Gymnosporangium Bermudianum (Farlow) Earle.
  Annual species.
    Gymnosporangium macropus Link.
    Gymnosporangium sp.[1]
Producing slight enlargement of stems or fasciation of branchlets.
  Perennial species.
    Gymnosporangium clavipes Cooke & Peck.
    Gymnosporangium nidus-avis Thaxter.

Of the above species *Gymnosporangium macropus* is the most conspicuous and widely distributed, its rœstelia occurring on the wild crab and the cultivated apple. We have also found it during the past year in Alabama growing on *Cratægus spathulata*. Its general distribution is doubtless coextensive with the wide distribution of its host, since its most common alternate host is as widely cultivated. In the

[1] The assignment of a name and description to this species has been left to Dr. Thaxter, to whom the writers are indebted for numerous comparisons of material and verifications of species during the past year.

south it is usually very common. It is found in South Carolina (*Ravenel*, Fungi Carol. no. 85), Georgia, Alabama, Mississippi, and is also reported from Florida (*Webber*) and Texas (*Jennings*). An interesting feature of its development occurred during the present season in Alabama, showing the effect of the season on habit of growth. An early rain caused the germination of some of the teleutospores, so that there was an early crop of rœstelias produced on the apples. At the time of the next rain, and after an interval of about six weeks, the remainder of the teleutospores were brought to germination, and at the same time the effects of the earlier sowing had already produced the characteristic spots and yellow thickenings of the rœstelias and the spermagonial stage was reached. Toward the end of July the new galls for the next season had already developed and had attained considerable size. With all our knowledge of this common species, we are still uncertain as to what may be the ordinary time and method of the formation of this gall on Juniperus.

Gymnosporangium clavipes, next to *G. macropus*, is the most common species in central Alabama. Since it produces no enlarged gall, its presence is often overlooked until after the germination of its teleutospores, when its semi-dried gelatinous spore masses render it quite conspicuous. Its Rœstelia is found on the cultivated quince and on various species of Cratægus. Its range appears to be confined to the Appalachian region. In the south it occurs in South Carolina (*Ravenel*, Fungi Amer. nos. 272, 502), Georgia, Alabama, and Mississippi.

An undescribed species of Gymnosporangium is the next most common in Alabama, and appears also to be frequent in Mississippi at Starkville (*Tracy*) and Ocean Springs (*Earle*). It is apparently an annual species producing galls similar to those of *G. macropus*, but of a peculiar red brown color and luster, reminding one of *G. Bermudianum*. In shape they approximate those of *G. globosum*, and are often very small, with single spore masses, but frequently have a peculiar ray like arrangement of four or five spore masses arranged at right angles to the (short) axis of the gall; occasionally they are larger, even reaching two or three centimeters in diameter. They are entirely devoid of the characteristic bark colored flakes of *G. globosum*. The spore masses are darker, shorter, broader and more conical than those of *G. macropus*, and are wholly unlike the dark wedge shaped masses of *G. globosum*. The spore characters are also different from either of the two allied species. The rœstelia of this interesting species is sus-

pected to be a peculiar undescribed form first discovered by Professor G. F. Atkinson in Alabama, and since by one of the writers on *Cratægus spathulata*. Cultures of the Rœstelia were attempted in the greenhouse on young plants of Cratægus transplanted from the woods (which afterwards proved to be *C. parvifolia*), but with negative results. Preparations are in progress to make more extended cultures another year on *C. spathulata*, which is one of the common species of haw in the vicinity of Auburn.

Gymnosporangium globosum is rare at Auburn, Alabama, occasional at Starkville, Mississippi (*Tracy*), and found once at Ocean Springs, Mississippi (*Earle*). A second form of this species, whose characters have not yet been fully studied, also occurs in Mississippi.

Gymnosporangium nidus-avis appears to be quite rare in central Alabama, only three specimens having been found the present season, all of them the branch form, and none of them producing the peculiar fasciation of the branchlets so common in eastern Massachusetts. They appear very early in the south, the teleutospores germinating during the rains of the latter half of February. A marked feature of the branch form of this species, readily distinguishing it from *G. clavipes*, is the peculiar orange colored stain left on the somewhat hardened inner bark of the host; this is perceptible even in specimens long collected. The species seems to have a wide distribution, in the south commencing with South Carolina (*Ravenel*, Fungi Car. no. 87, distributed as *G. Juniperi*), and extending through Georgia (*Ravenel*, Fungi Amer. no. 791, distributed as *G. conicum*), Alabama, and Mississippi. A peculiar form appears in the collection of the Division of Vegetable Pathology and Physiology, which Professor Galloway has kindly permitted us to examine, under the name of *G. juniperinum*, collected at Fredericksburg, Texas, by F. Grasso in 1893 and again in 1895. It resembles closely certain foliicolous forms of *G. clavipes*, but the spore masses are larger and more prominent and the pedicels are not enlarged. It is desirable that we have as wide a series of specimens as possible from the entire Gulf region in order to determine more fully the limits of these species as well as their geographic distribution.

The last species of the list, *Gymnosporangium Bermudianum*, has the most limited distribution in the Gulf region, and is as remarkable in its life history as in its distribution. It is known from the Bermuda Islands, where it was first collected by Professor Farlow and described

by him as Æcidium,[2] and from Ocean Springs, Mississippi, where one of the present writers discovered its true gymnosporangial character, and also its peculiar rœstelia, in 1892. The Mississippi material was first collected in January 1887 and sent to Professor Farlow, so that Mississippi is one of the type localities of the original description. Later in the spring of 1892 the teleutospores were discovered, and in October of the same year the rœstelia with its distinct, long exserted, lacerate peridia was found on the same galls, the old broken bases of which must have formed the peridia of the supposed Æcidium as originally described. The species, therefore, unlike all its congeners, produces its æcidial and teleutosporic stages on the same host, from the same gall, and in all probability from the same mycelium. The species can scarcely be said to be common, though when found it usually infests considerable portions of the tree in which it occurs. Several stations are now known for the parasite at distances of a few miles from the original tree where it was found in 1887.

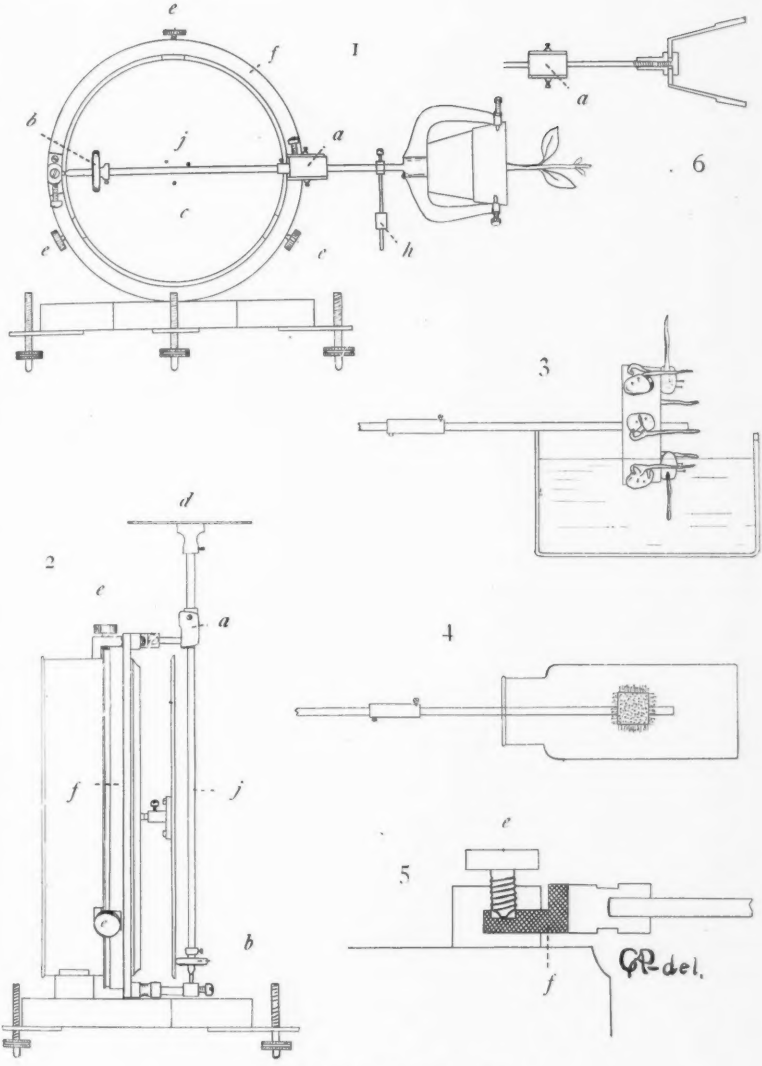
The conditions of growth manifested by the last species introduce a new and interesting problem into the question of the evolution of the various species of the genus. At one extreme of the series we have *G. macropus* and its new ally, annual species, producing their rœstelias on various Pomaceæ and consequently dependent for their perpetuity upon the success of their annual sowing and interchange of host. Then we have the various species that are perennial and thus capable of continuing from year to year without the intervention of the rœstelia stage, but with which they continue to propagate themselves more widely. Then, finally, we have *G. Bermudianum* producing both stages on the same host and therefore independent of the Pomaceæ for its continuance. The details of this evolution will constitute a further problem.— LUCIEN M. UNDERWOOD and F. S. EARLE, *Auburn, Alabama.*

BOTANICAL APPLIANCES.

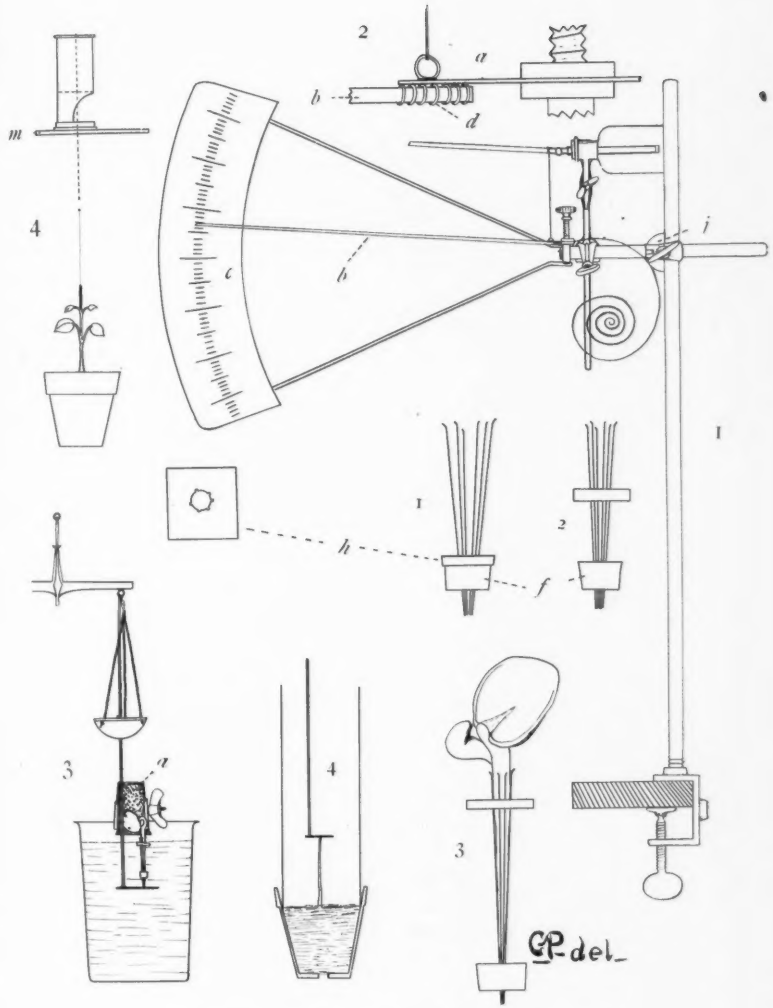
(WITH PLATES IX AND X.)

BOTANICAL appliances serve for investigation and demonstration, and while some of the following appliances were devised for special work they have also been used in demonstration in a practical course of vegetable physiology in our laboratory.

[2] *Æcidium Bermudianum* Farlow, BOT. GAZ. 12:206. 1887.



STONE on a CLINOSTAT.



STONE on BOTANICAL APPLIANCES.

Clinostat (*pl. IX*).—The phenomena of heliotropism and geotropism are of such fundamental importance that I believe it would not be out of place to offer demonstrations of them in secondary schools, especially since our elementary text-books lay some stress on plant physiology. It was partially with this idea that this instrument was devised, and in its construction we have endeavored to obtain a cheap and compact piece of apparatus, and one at the same time which will illustrate all of the principles. Undoubtedly the best clinostat which has been devised for general purposes is that of Pfeffer, made by Albrecht of Tübingen at a cost of $80. It can be adjusted to different rates of speed and is furnished with a powerful spring which enables it to run twenty-four hours without rewinding. An excellent clinostat is that of Wortmann, made at Strassburg, and costing about $60. So far as compactness is concerned this is the best, but a great drawback is that it has to be wound every twelve hours. Every laboratory where plant physiology is taught should endeavor to have one of the above, but when it is necessary to have more than one, or in case an instrument for illustrative purposes only is needed, a simpler and cheaper one will frequently answer as well. Such an instrument I have used in modified forms for three years. Briefly stated, it consists of an eight-day spring Waterbury clock (*figs. 1* and *2*) with a disk attached to the hour hand spindle which moves a shaft provided with a small friction wheel to which the plants are attached. The disk (*c*) is of aluminum 2^{mm} thick and 47^{mm} in diameter, fastened to the hour hand spindle by means of a set screw. The hour hand spindle is lengthened to extend beyond the face of the clock, and is larger and provided with a better bearing than is ordinarily supplied with the clock by dealers. This gives to the movement greater stability, although I have used the ordinary spindle with success. Shortening the hair spring of the balance wheel of the clock causes the hour hand spindle, and consequently the aluminum disk, to make a revolution every half hour.

In front of the disk there is a steel rod shaft (*j*) which runs on a point at the base and in an elongated bearing at the top and is provided with a swivel joint to prevent lateral friction. On this steel rod and at right angles to the disk there is a small brass wheel (*b*) 23^{mm} in diameter covered with a solid rubber ring, a tire, which is in direct contact with the disk. This wheel constitutes a friction wheel and revolves when in contact with the aluminum disk. It can be moved

by means of a set screw to any position on the rod required, thus enabling one to modify the speed.

If, for example, the friction wheel be placed upon the shaft near the center of the disk, the speed is retarded; if, on the contrary, it is placed near the circumference, then the speed is accelerated. When the friction wheel is 23^{mm} from the center of the disk, the small shaft revolves once every half hour, at a distance of 46^{mm} from the center it revolves every fifteen minutes, and when at 69^{mm} it revolves in seven and one-half minutes. In fact any degree of speed can be obtained between seven and one-half and thirty minutes. Should it be necessary to obtain a higher speed a smaller friction wheel can be used, or the hair spring can be shortened still further. *Fig. 2* shows a side view of the clinostat when set up for the purpose of eliminating the effects of light, the plants being placed upon the horizontal disk (*d*). In *figs. 1, 3, 4,* and *5* the instrument is shown when in use for gravity experiments. In the latter instance the steel rod is placed horizontally. The apparatus is so arranged that any angle can be obtained. This is accomplished by means of three set screws (*e*) which are attached to the clock and fit into depressions in the metal rim (*f*) which is movable. This mechanism is shown more in detail in the enlarged cross-section of *fig. 5*, the metal rim being represented by the shaded portion. By loosening the three set screws (*e*) the rim can be revolved, and as the shaft attachments are connected with the rim they move with it. In *fig. 1* a holder is attached to the end of the shaft for the purpose of carrying the plant. The pot used is 2^{in} in diameter, and is centered and held in place by means of three screws. A simpler method of holding the plant is shown in *fig. 6*, where the end of the shaft is made to pass through a hole in the bottom of the pot, the pot being securely held in place by means of a double flange. The shaft is also provided with a balance wheel (*h*). In order that the plant may be balanced it is only necessary to remove the friction wheel from the disk, which allows the shaft to revolve freely, then adjust the compensating weight (*h*), bringing the center of gravity of the pot within that of the shaft. Instead of using a growing plant in the pot, grass nodes, or flower stalks, can be readily substituted. For eliminating the effect of gravity in roots the apparatus is set up as shown in *fig. 2*, in which case the roots are kept from drying up by revolving in a dish of water.

For Phycomyces or Mucor it can be conveniently arranged as in *fig. 4*, in which case the shaft is elongated. The clinostat is mounted

on a wooden base provided with three leveling screws and will run four days without winding. It is made especially for light objects although I have carried fourteen pounds on it in a horizontal position for a number of hours. The apparatus could be constructed, I suppose, for about $15.

Spring dynamometer (*pl. X, figs. 1* and *2*).—This apparatus was devised for the purpose of measuring the power of growth induced by geotropism in grass nodes. It consists of a watch spring (*a*) having attached to its end a straw (*b*) which amplifies the movement on the graduated scale of the arc (*c*). The straw is held securely by means of a spiral wire (*d*) soldered to the underside of the spring, allowing the straw to be removed at leisure. Directly above this straw is a wire loop for attaching a thread, the other end of which is fastened to the grass culm at a distance from the node of ½in. The grass culm has its lower end inserted in a bottle containing water provided with a perforated cork through which is placed a glass tube tightly fitting the culm, thus holding it securely. The bottle is supported by an Arthur clamp and is mounted on a vertical rod which can be adjusted to any desired angle by a unique joint (*j*) made by the O. C. White Company, Worcester, Mass. By lengthening or shortening the spring the tension can be readily varied. In the illustration the whole watch spring is shown, but of course only a short piece is necessary.

Apparatus for measuring and recording root-growth (*pl. X, fig. 3*).—Having had occasion in my experiments to record the hourly increments of growth in the length of a large number of roots I was obliged to devise a self-regulating apparatus for this purpose. So far as I am aware no self-registering appliance has been employed in the growth of roots. The method in general use consists in direct readings with a horizontal microscope. Any one who has employed this method must be aware that it is exceedingly tedious, and, moreover, that it is not accurate on account of the nutation of the root, which under high magnification is liable to give rise to serious errors in the readings. The root constitutes one of the most delicate organs of a plant, and it is clear therefore that whatever apparatus we use must be of the most sensitive kind. It must be able to keep the root straight, yet allowing a certain amount of play; it must be constructed out of material which will not injure the root; and the apparatus which multiplies the growth must possess the least resistance possible.

In describing this apparatus it will not be necessary to go into the

details of the experiments which I have made with various contrivances. It is sufficient to say that I have never detected the slightest influence of any description detrimental to the normal growth of the root on account of its use. The apparatus consists of a simple hand balance with a light straw attached to one arm and a metal rod to the other.[1] The lower end of this rod has a metal disk attached to it and is suspended in a beaker of water. The root is fastened securely by pinning the seed to a cork (*a*) held by a clamp. Surrounding the lower end of the root is a harness which eliminates all curvatures and keeps the root straight. The lower end of the harness is in direct contact with the disk, and every increment of growth of the root in length causes a corresponding depression of the balance arm, which movement is multiplied and registered by means of the straw on a recording cylinder. The details of the harness are shown in cuts *1*, *2*, and *3*. It consists of six long nickel plated wires, such as are used for insect pins. These are passed at equal distances from each other through a piece of cork (*f*) 5^{mm} in diameter. They are not passed vertically through the cork, but spread at the top as shown in *1*. Another smaller piece (*h*) has a circular hole provided with grooves for the pins, and enables them to be adjusted to the root. By sliding the cork up the wires are brought into close contact with the root and by sliding it down the root is released. It is necessary that the harness should not clasp the root too tightly, but just fit easily. The harness figured is made for *Vicia Faba*, and it would not be advisable to use it for other species. A delicate mechanism, however, could be constructed entirely out of metal which could be adjusted to any root. With the hand balance as a multiplying agent I have never used a weight for the root to overcome which exceeded 50^{mg}. As the straw does not pass through a vertical line in its movements, there is a slight error in registering, but it is so minute that it need not be considered, as for every millimeter's growth of the root in length the error in our apparatus would equal but $\frac{1}{400}^{mm}$. The same multiplying apparatus can be used also for measuring the growth of the cotyledons in grasses, in which instance a paper cylinder is placed around the cotyledon to eliminate the effects of light. By applying the harness to the cotyledon, the power of growth can also be obtained.

Nutating apparatus (*pl. X, fig. 4*).—This instrument is similar to that recommended by Wiesner, who has justly criticised the method

[1] *Cf.* BOT. GAZ. 17: 105. 1892.

used by Darwin. It consists of a diopter made out of a short metal tube 2.5^{in} high and 1^{in} in diameter, having a section cut out of its lower half for the purpose of inserting a pen. In the inside of the tube is a coverslip (represented by the horizontal dotted line) with two cross hairs, and at the top another coverslip with a round dot upon it. Both the hairs and the dot are centered in the tube. When the dot at the top coincides with the cross hairs below, the line of vision extends directly through the center of the tube which rests upon the horizontal glass plate *m*. When the dot and cross hairs are made to coincide with the black wax point on the glass capillary attached to the plant (which is for the purpose of amplifying the nutation movements) a direct line of vision is obtained and recorded by means of a pen on the glass plate (*m*). The glass capillary is secured to the plant in the usual manner by means of wax, and the multiplication of the nutation movements can be increased or diminished by lengthening or shortening it. Professor Wiesner used two horizontal glass plates instead of one, but since the lower part of the diopter is cut out for the purpose of inserting a pen, only one plate is necessary. —C. E. STONE, *Massachusetts Agricultural College.*

EDITORIAL.

Botanical Meetings in Buffalo.

THE BOTANICAL MEETINGS in Buffalo in connection with the American Association were remarkably successful. American botanists were present in large numbers, and the attendance was well sustained throughout the almost continuous sessions of six days. During two days preceding the meeting of the Association the Botanical Society was represented by eleven of its twenty-three members, and the papers presented were of a type that justified the existence of the organization. With the opening of the Association, however, it became evident that the Section of Botany and the Botanical Club were to have the most largely attended sessions of their existence. In Section G more than forty papers were upon the programme. These papers, moreover, were notably strong, representing well the great increase of botanical activity in this country. The most notable feature of the meeting was the presence of a large representation of our younger botanists, who have been trained in the newer methods, and whose crisp and clear presentations of important work augured well for the future of American botany. The Botanical Club, also, was full of papers which would rank better than most of the papers in the Section a few years ago. To one in familiar contact with American botany for a number of years there could be no better evidence of wonderful development than the Buffalo meeting. It seems to the GAZETTE a serious mistake on the part of the botanist as an individual, and as the representative of an institution which seeks botanical students and influence, to neglect such meetings. Such neglect must reflect upon the individual and the institution and weaken any hold upon a botanical constituency. We would especially commend such meetings to the younger race of botanists. The older botanists, who have cultivated a habit of neglect, doubtless will continue to do so, but it is at the expense of declining to be of great service in personally stimulating the progress of botanical science.

Scientific Chief Department of Agriculture.

THE MATTER of the director of the scientific work in the Department of Agriculture came before the American Association for the Advancement of Science at the Buffalo meeting. The proposition to create such an office received the warm endorsement of the Association, as it has of almost every body of men to which it has been presented. It is worthy of note that the action was vigorously advocated by the only chief of division in the department who was present at Buffalo, indicating that other divisions, if not the botanical ones, favor the plan.

The open letter opposing the creation of this office is its own best answer. The writer acknowledges that the botanical divisions have, like Topsy, "jes' growed." Unfortunately the conditions did not — perhaps could not — conduce to symmetrical development and the gardener's hand is needed to prevent lopsided, ragged, and unsightly forms. This does not mean that the vigorous plant is to be clipped into a geometrical figure, but that it is to be brought to the highest degree of natural symmetry.

When it is so that one division cannot have opportunity to grow the plants it needs, though other divisions have abundant greenhouse facilities, it is quite evident that someone, with the same functions as a college president, is required to coordinate — not to subordinate — the divisional work. How proper coordination could interfere with, instead of promoting, research and "practical" work, is difficult for us to understand.

OPEN LETTERS.

BOTANICAL WORK OF THE DEPARTMENT OF AGRICULTURE.

To the Editors of the Botanical Gazette:—In the editorial pages of a recent number of the GAZETTE, attention is called to the botanical investigations of the Department of Agriculture, the statement being made that under the present arrangement there is a dissipation of energy and a duplication of work, which would be overcome by combining the divisions of botany, forestry, agrostology, and vegetable physiology and pathology. I feel sure the writer of the article in question is not fully conversant with all the facts in the case, else he would see that such a plan as proposed would be a most decided step backward.

Strictly speaking, the work of the divisions mentioned is for the most part botanical. They all deal with plants, and botany is the science of plants, both wild and cultivated. If we accept this definition we might include the branches of the department engaged in horticultural work, for horticulture has for its very foundation botany pure and simple. These branches, however, may be omitted from the discussion, and on the ground that botany is the science of plants, the four divisions mentioned, representing the scientific study of plant culture in the department may logically be included in one group, call it bureau, division, or any other name. While this would be a logical arrangement according to the definition of the term botany, the same would hold true for a grouping of the bureau of animal industry, the division of entomology, and the division of the biological survey (ornithology and mammalogy), on the ground that their work is zoological. Botany, in other words, is as broad a field as zoology, and the various branches are as distinct in one case as in the other. The men engaged in the forestry work, for example, are authorities in their line and are recognized everywhere as such by both scientific and practical men. They are not supposed to know any more about vegetable pathology than they do about entomology, chemistry, or any of the kindred sciences. Vegetable pathology, on the other hand, as a science has nothing more in common with forestry than it has with agriculture or horticulture, using these terms in their broadest sense.

Every botanist in the country is aware that the division of botany proper does not cover the whole field of botany, and doubtless, as the editor says, it should be rechristened, to indicate more definitely the scope of its work. In the past this has largely been a systematic study of our flora, and as a result

one of the largest and most valuable collections of plants in the world has been built up. The Smithsonian Institution has recently assumed charge of this collection, for which it has always been responsible, and thus relieved of this part of the work, the division of botany, of the Department of Agriculture, can continue its important economic investigations on weeds, pure seed, the geographic distribution of plants and their relation to environment, etc., all of which are distinct from those being pursued by other branches of the department.

Omitting further argument, the chief reasons for maintaining the present autonomy of the divisions may be summarized as follows:

(1) The work of each division is distinct and well defined, having been the result of gradual growth and in accordance with the natural development of the department as a whole.

(2) There is no duplication of work, not even in office or routine matters. The division of vegetable physiology and pathology may receive and answer 5,000 letters a year, all of which relate wholly to its work and involve a certain amount of labor, which could in no wise be saved by a concentration of effort. The same is true of its bibliographical work and such necessary labor that must be given to the collection of fungi, representing the economic phase of the division's investigations.

(3) The chief incentive which keeps good men in the department is that they have freedom in their investigation. The men in charge know the details of their own lines of work perhaps better than any one that could be put over them. They are in direct touch with the people for whose benefit the investigations are made, and it is only since this has been brought about that the work of the department in the main has come to be looked upon as a credit to the country. The moment the autonomy of the divisions is destroyed, which would certainly be the case if the plan proposed were carried out, the principal incentive for good work will be at an end.

B. T. GALLOWAY, *Washington, D. C.*

LOCAL FLORAS.

To the Editors of the Botanical Gazette:—I am interested in what you say editorially in regard to the scope of local floras. I agree very heartily with the proposition that a local flora should be more than a mere list and should not be confined by artificial bounds. Everyone who has worked faithfully on a local flora has felt this trouble. Much more could be printed in our floras were it not for expense of publication. I see no excuse whatever for the publication of lists that say nothing about the plants themselves and the problems of their distribution, and yet devote hundreds of dollars to

printing long lists of synonyms, dates, and references to prior publication.

Some time we shall all do better in this kind of work, but there is an immense amount of work to be done before the ground can be cleared for more valuable investigation. When much of the work now going on is put together as a whole, I think it will appear more valuable than it does at present.

EDWARD L. RAND, *Boston, Mass.*

THE AUTHORSHIP OF CERTAIN NAMES.

To the Editors of the Botanical Gazette:—Contribution U. S. Nat. Herb. 3: no. 9, just to hand, suggests a query as to the authorship of two new names proposed therein. On page 572 we have "*Salix barrattiana tweedyi* Bebb, var. nov.;" but it is explained by Mr. Rose in a footnote that the late Mr. Bebb gave the variety another name, which was preoccupied, and that he (Mr. Rose) substituted *tweedyi*. It appears to me that we cannot possibly cite as Bebb's a name he never wrote, or even thought of, and the status of the matter is the same as if Bebb had published his description with the preoccupied name, and Rose had offered a substitute in a later publication. Consequently it must be *S. barrattiana tweedyi* Rose.

A more difficult question arises in regard to "*Crepis barbigera* Leiberg, sp. nov," page 565. From the appearance of the description, and the absence of quotation marks or any statement to the contrary, we are led to suppose that it was written wholly by Mr. Coville. Now if Mr. Leiberg merely ticketed specimens of a new Crepis with the name *barbigera*, this name would be nothing but a *nomen nudum*, and the author of the species would be he who first gave or cited a description in connection with the name. Nevertheless, we may, I think, still regard *Crepis barbigera* as Leiberg's species, even allowing the description to be Coville's, by assuming that the latter prepared a diagnosis, to which the former gave a name. The status of the matter then is the same as if Coville had published a nameless description, and Leiberg had in a later paper proposed a name.

T. D. A. COCKERELL, *Mesilla, N. M.*

CURRENT LITERATURE.

BOOK REVIEWS.

An American illustrated flora.

STUDENTS of American plants have been wont to regard their transatlantic associates with envy on account of their numerous helps in determining plants. It seems as though no European should go astray in the recognition of the plants about him. In America, however, we have, of necessity, accustomed ourselves to bare texts, expressive as they could be, but not half expressive enough. The Gray Manual region is certainly our best known region, but to the average student of wild plants there remain in it more plants that he is uncertain about than those that he absolutely knows. He probably names almost all of them, but the mental question mark is appended to more of them than he would like to acknowledge. Most of this has arisen from the lack of that clearest of all kinds of presentation, accurate illustration. Illustrated works upon American plants have been projected, and have advanced to various stages of completion, but even had they all reached a happy conclusion they have either been too elaborate for common use or too popular to be of scientific value. The work we were waiting for was one that should be complete in illustration, scientifically accurate, and still of moderate cost. That such a work has appeared [1] will be a surprise to many and a great boon to all.

The field of this work is entirely unoccupied, and its publication marks a new impulse in the study of the so-called "manual plants." The order of presentation, beginning with the lowest forms, is but an expression of modern methods, and should have been adopted by manuals long since. The sequence of orders follows the same tendency and gives us, so far as any lineal arrangement can, the best we know concerning natural sequence. The distinct policy of multiplying families and genera is followed, these groups being regarded as matters of convenience, and convenience being increased by segregation. There can be no question as to the convenience of the plan if the determination of the plants be the sole object. The question may be

[1] BRITTON, NATHANIEL LORD and BROWN, HON. ADDISON.—An illustrated flora of the northern United States, Canada and the British Possessions, from Newfoundland to the parallel of the southern boundary of Virginia, and from the Altantic ocean westward to the 102d meridian: in three volumes. Vol. I. Ophioglossaceæ to Aizoaceæ. Pp. xii+612. New York: Charles Scribner's Sons. 1896. $3.00 a volume.

raised, however, whether this recognition of all easily separable groups may not suppress too much the fact of larger groupings which any natural scheme must involve. Perhaps it is not possible to carry out one purpose well without distorting something else, and it becomes a question of judgment as to what must be sacrificed.

Every species is illustrated, and when one is reminded that about 4,000 species of pteridophytes and spermatophytes are found within the region covered, the undertaking seems enormous. The illustrations are set in the text, opposite the description, and in most cases three species fill a page. The figures are excellent and clearly printed, showing just the features needed for discrimination, and eliminating all the unnecessary "picture" element. In the first volume the figures number 1,425, and more than three-fourths of them are of species that have never been figured before.

In such a work the question of nomenclature is a mere incident. It need only be remarked that the nomenclature is a consistent carrying out of the principles enunciated in what is known as the Rochester code and exemplified in the "Check-List," and that its embodiment in a work of this character will go far towards establishing it. The prominence given to synonymy easily offsets the inconvenience of new names.

To this first volume Professor Underwood has contributed the text on the Pteridophyta, Mr. F. V. Coville that of the Juncaceæ, Dr. John K. Small that of the Polygonaceæ and Euphorbiaceæ. Mr. Arthur Hollick has had supervision of the drawings in general, and Professor F. Lamson-Scribner of those of Gramineæ. The work of the late Dr. Morong is also seen in the groups to which he paid chief attention, many of which are included in the present volume.

When all the assistance has been accounted for, however, the fact remains that it represents an enormous amount of hard and patient work on the part of the authors. It is to be hoped that the gratitude which is their due will find its expression in the immediate exhaustion of the first edition. Certainly no American botanist, who has any occasion to determine plants, can afford to be without this greatest help since the original publication of Gray's Manual. We look forward with great interest to the succeeding volumes, an interest all the greater as they will contain a better representation of Professor Britton's own work, and will deal with groups of larger general interest. It is to be hoped that nothing will delay their speedy appearance, so that the volumes may be practically synchronous, although the amount of work involved would seem to make this well-nigh impossible.—J. M. C.

NEWS.

DR. DOUGLAS H. CAMPBELL has spent the past summer in Japan.

THE OFFICERS of Section G of the A. A. A. S. for the next year are G. F. Atkinson, *Vice President;* F. C. Newcombe, *Secretary.*

IN THE ABSENCE of Mr. Coville, President of the Botanical Club at its Buffalo meeting, Professor W. A. Kellerman was appointed.

THE OFFICERS of the Botanical Club for the next year are S. M. Tracy *President;* L. R. Jones, *Vice President;* E. S. Burgess, *Secretary.*

MR. C. H. PECK and Mr. B. T. Galloway were elected members of the Botanical Society of America at its Buffalo meeting, bringing the number of members to twenty-five.

EDWIN B. COPELAND, of the University of Wisconsin, has returned from a year's study in the botanical institutes of Tübingen and Halle, from the latter of which he received the doctor's degree *summa cum laude.*

THE BOTANICAL SOCIETY at its Buffalo meeting was represented by the following members: Atkinson, Bailey, Barnes, Bessey, Britton (E. G.), Britton (N. L.), Coulter, Hollick, MacMillan, Trelease, and Underwood.

MR. A. P. ANDERSON, assistant in botany at the University of Minnesota, who has been studying abroad for two years, received the doctor's degree from the University of Munich in August, and has since returned to this country.

MR. O. F. COOK has been appointed curator of the cryptogamic collections of the National Herbarium, under the Division of Botany. He has the privilege of leave of absence to visit Africa whenever his duties there demand it.

THE OFFICERS of the Botanical Society of America for the next year are John M. Coulter, *President;* C. S. Sargent, *Vice President;* C. R. Barnes, *Secretary;* Arthur Hollick, *Treasurer;* B. L. Robinson and F. V. Coville, *Councillors.*

PROFESSOR A. N. PRENTISS, formerly Professor of Botany at Cornell University, died at his home in Ithaca, Aug. 14th. A biographical sketch of Professor Prentiss, prepared by his successor, Professor Atkinson, was published in BOT. GAZ. **21**:283. 1896.

IN RESPONSE to a suggestion by Professor S. M. Tracy, Section G of the A. A. A. S., at the Buffalo meeting, appointed Professors N. L. Britton and John M. Coulter as a committee to take under consideration the subject as to what should be the usage of the phrase "type specimen."

THE MEXICAN BOTANICAL CLUB is an organization which can be made very useful to botanists who desire to cultivate Mexican plants for study. Those who wish for a fuller knowledge of its purpose and of its ability to serve botanists should communicate with William Brockway, Tuxpan, Michoacan, Mexico.

ATTENTION IS CALLED to the circular issued by the Pasteur Monument Committee and distributed with this number of the BOTANICAL GAZETTE. The opportunity to honor the memory of Pasteur in a most effective way is one that botanists will not pass by. The senior editor of the GAZETTE has been asked to collect and forward subscriptions.

IN ALL PROBABILITY the next meeting of the American Association for the Advancement of Science will be held in Toronto in connection with the meeting of the British Association. As it is understood that British botanists will be well represented at that meeting large numbers of American botanists will doubtless take advantage of the opportunity to welcome their transatlantic friends.

THE ADDRESS of Dr. N. L. Britton as Vice President of Section G of the A. A. A. S. at its Buffalo meeting was an admirable presentation of the history and status of botanical gardens, made still more attractive by numerous lantern slides. The GAZETTE would have been glad to publish the address in full, according to its usual custom, but Dr. Britton's connection with the New York Botanic Garden made other publication seem desirable.

A BEQUEST has been made to the Swedish Academy of Sciences to promote the study of the Brazilian flora. Every eight years it yields about $5,500, which is applied in sending two Swedish botanists to Brazil for a period of two years. One payment has already become available, and Dr. C. A. M. Lindman and Dr. G. O. A. Malme undertook the first expedition (1892–4), exploring especially the Rio Grande, Paraguay and Matto Grosso. The donor and originator of the enterprise was Dr. A. Regnell, a Swedish physician, who lived for fifty years in Brazil, and made important collections and studies of the phanerogamic flora.

THE BUFFALO BOTANIC GARDEN was established in 1894, replacing what was known as South Park. It contains 160 acres of finely situated and very diversified surface, and although planting began only last year, it has already in cultivation nearly two thousand plants. It is the design to arrange the plants in families, so far as conditions will permit. Mr. John F. Cowell is the very competent director, and Judge David F. Day is one of the park commissioners, facts which augur well for the future of the garden as a scientific establishment. It is due to Mr. Day's influence that the garden was established, and it is a fitting monument to this long time lover and student of plants.